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Some Empirical Evidence from Publicly Quoted UK Companies on the Relationship Between the Pricing of Audit and Non-audit Services

M. Ezzamel, D. R. Gwilliam and K. M. Holland*

Abstract—Using data obtained from a sample of 314 UK quoted companies (excluding financial sector companies), this paper examines three aspects of the relationship between fees for audit and non-audit services: (a) the extent and nature of the provision of non-audit services to audit clients; (b) whether the positive association between the level of audit fees and non-audit services fees found in the majority of non-UK studies holds in the UK; and (c) whether it is possible to throw further light on the nature of the relationship between audit fees and non-audit services fees by exploring the interaction between non-audit services and other factors that appear to affect audit pricing. Our results suggest that: (i) income earned by audit firms from non-audit work for quoted clients averaged nearly 90% of the levels of audit fee earnings in 1992/93 (and more than a quarter of clients paid more for non-audit services than for the audit); (ii) the extent of voluntary disclosure of the breakdown of non-audit services was limited and the existing disclosure requirement allowed considerable variety in the manner in which non-audit services fees incurred or paid abroad were disclosed; (iii) there was a significant positive association between fees for audit and non-audit services similar to that reported in the majority of US and Australian studies; and (iv) four of the nine interaction terms introduced were significant, implying that non-audit services fees may moderate the association between other explanatory variables and audit fees.

1. Introduction

Accounting and auditing firms have throughout their history provided a variety of services other than audit both to audit and non-audit clients. In recent years, the scale and extent of these services have increased substantially to the point where they now form the greater part of the leading accounting firms' revenues. Figures reported for the UK show that in 1993–94 the percentage of total fee income of the Big Six firms derived from services other than audit and accountancy ranged between 55% and 81%.[1] Concerns have arisen over whether provision of non-audit services on this scale may compromise auditor independence.[2] Moreover, there are potentially important implications with respect to the pricing of both audit and non-audit services which may be caused by complementarities on both the supply and demand sides. Thus, to the extent that there may be knowledge spillovers and overlap in the supply of both services by one audit firm to the same client, so economies of scale and scope may affect the fee levels of either (or both) audit and non-audit services. Similarly, to the extent that the demand for audit and non-audit services is joint, some of the savings in marketing and bidding for both services may be passed on to the client.

Over the last two decades, the pricing of audit services has been tested extensively. Increasingly,

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[1] *Accountancy*, July 1994: 15.

[2] For example, shareholder concern has been reported at BP where in 1993 non-audit services fees paid to its auditors, Ernst & Young, amounted to £11.3m, compared with an audit fee of £6m. Commenting on the award to Ernst & Young of the contract for BP's Europe-wide internal audit services, Alan MacDougall, managing director of institutional shareholder consultancy PIRC, commented: 'It is pretty outrageous. I do not see how the reappointment of the auditors can be recommended.' (*Accountancy Age*, 31 March 1994).

researchers have focused on the role of non-audit services and the possible links between the pricing of audit and of non-audit services. Most of the early literature on non-audit services fees was directed to establishing the extent to which auditors were involved in providing non-audit services (Scheiner and Kiger, 1982) and examining the impact of a requirement to disclose non-audit services fees on the extent of the provision of non-audit services (Scheiner, 1984). More recent studies have explored the possible interrelationships between the pricing of audit and non-audit services, for example, Simunic (1984); Palmrose (1968a); Abdel-khalik (1990); Turpen (1990); Davis et al. (1993); and Barefield et al. (1993) in the US, and Francis and Pollard (1979); Craswell et al. (1993); Butterworth and Houghton (1993); and Barkess and Simnett (1994) in Australia.

This recent emphasis on researching non-audit services has improved our understanding of the relationship between the pricing of audit and non-audit services. However, relatively little of this research has focused on the UK market for audit and non-audit services. Gwilliam (1987, Chapter 3) discusses differences in the accounting and audit environment between the US and UK and argues against the general assumption that US research results translate automatically to the UK environment. The majority of US non-audit services studies are based on data from the late 1970s and early 1980s, when the provision of non-audit services to clients was significantly less extensive than it is today in the UK. US data for the Fortune 500 for the period 1978–80 shows that average non-audit services fees were less than 25% of the average audit fee (Parkash and Venable, 1993). This contrasts with the much higher figures reported in this study.

Furthermore, there may be differences in the nature of the non-audit services markets in the two countries, with UK firms more successful than their US counterparts in maintaining a dominant position in taxation advice and in extending their influence into new areas such as corporate finance. In fact, a number of the US studies have focused on consultancy aspects of non-audit services to the exclusion of taxation and other forms of non-audit services that may be relatively more important in the UK. The lack of any compulsory requirement for the disclosure of fees for either audit or non-audit services has meant that the majority of US results have relied on questionnaire data.[3] Apart from doubts about the accuracy of such data, the response rates achieved were typically low, and Parkash and Venable (1993) suggest that non-response bias may have contributed to the conflicting results obtained.

This inconsistency in the results obtained to date is another motivation for further study. While the majority of the previous studies reviewed in the next section report a positive association between audit fees and non-audit services fees, some find no evidence of association between the two variables (for example, Simon and Francis, 1988; Abdel-khalik, 1990; Barefield et al., 1993).[4]

A final motivation for this research is that of exploring further the relationship between the pricing of audit and non-audit services by means of examination of the manner in which other explanatory factors, for example auditee size, may indirectly moderate the associations between non-audit services fees and audit fees. Whereas the use of interactive or moderating terms has been common in the application of multivariate analysis to other fields of accounting study, this has not been the case in the non-audit services pricing literature. Simunic (1984) introduced certain interactive variables, but few other studies have included interactive terms, even though a priori it does seem likely that linkages between other factors and non-audit services, which may influence the relationship between levels of non-audit services and audit fees, do exist. The formulation of specific hypotheses about the nature of these linkages is restricted by the lack of an established theoretical foundation for the purchase of non-audit services and the association between audit and non-audit services fees. However, in Section 4 of the paper we do offer a number of potential linkages which are subsequently tested.

The remainder of this paper is divided into four further sections. First we give a brief summary of previous research. Then we proceed to discuss the nature of the recently introduced UK requirement for the disclosure of non-audit services fees, and to present the initial results on the extent and nature of these disclosures. The main research method and results are identified in the following section, and the paper concludes with a discussion of these results and their implications.

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[3] The studies of Simunic (1984), Palmrose (1986a, 1986b), Simon and Francis (1988), Abdel-khalik (1990) and Turpen (1990) all relied on responses to a questionnaire survey to obtain their underlying data. Simon (1985) used data for those firms that disclosed the information on a voluntary basis. More recent studies by O'Keefe et al. (1994), Davis et al. (1993) and Barefield et al. (1993) had access to audit firm data.

[4] There are other examples of conflicting results. Whereas Simon and Francis (1988) found no indication that a firm switching auditors purchased higher than normal non-audit services, and De Berg et al. (1991) found there to be a significant decline in non-audit services fees following a change in auditor, other studies, e.g. Butterworth and Houghton (1993) and Barkess and Simnett (1994), have found there to be an increase in non-audit services fees following a change in auditor. Beck et al. (1988) find evidence of a positive association between the provision of (recurring) non-audit services and the length of the auditor's tenure, whereas Barkess and Simnett (1994) find no association between non-audit services provision and auditor tenure.

2. Previous research

As noted above, the majority of the empirically-based US pricing studies have reported a positive association between the level of non-audit services fees and audit fees (for example, the studies of Simunic, 1984; Simon, 1985; Palmrose, 1986a; Turpen, 1990; and Davis et al., 1993). This relationship was found to hold for a variety of non-audit services such as management advisory (Simunic, 1984), tax, accounting related and non-accounting related services provided both by the incumbent and non-incumbent auditors (Palmrose, 1986a). Moreover, the study by Davis et al., (1993) found that the link between non-audit services fees and audit fees was explicable in terms of additional audit effort rather than as a pricing premium. Three Australian studies (Craswell et al., 1993; Butterworth and Houghton, 1993; Barkess and Simnett, 1994) also reported a significant positive association between non-audit services fees and audit fees. In contrast to these studies, a number of US researchers could find no significant association between non-audit services fees and audit fees (for example, the studies of Simon and Francis, 1988; Abdel-khalik, 1990; Barefield et al., 1993; O'Keefe et al., 1994).

The majority of these studies have been empirically rather than theoretically driven, although Simunic (1984) explored the underlying relationships between the pricing of audit and non-audit services in the context of the existence of efficiencies from joint production. Where the provision of non-audit services results in what Simunic terms a 'beneficial knowledge spillover' then, provided that the demand for audit is price-elastic, the total client expenditure on audit will increase. While Simunic's analysis is helpful, in practice the extent and nature of these spillover effects is problematic and is likely to vary according to the nature of the non-audit service being undertaken. For example, whereas work on financial control systems may result in improved systems and possible audit cost savings, due diligence work on prospective acquisitions is only likely to have a spillover effect if the acquisition proceeds. The extent and nature of any spillover effects may also be affected by Chinese walls within the audit firms, designed to reduce interaction between audit and non-audit teams working with the same client.

Furthermore, there is no clear consensus about the nature of the elasticities of demand for audit and non-audit services, although it might be conjectured that there is a significantly greater elasticity of demand for non-audit services than for audit. To the extent that these elasticities are crucially important to the prediction of whether there is a positive or a negative association between audit and non-audit services fees, interpretation of empirical results obtained is problematic.

An alternative explanation for the overall price linkage between audit and non-audit services is that it is not the outcome of a direct interaction between the two services provided, but rather the result of a factor or combination of factors not adequately controlled for in the pricing model which are driving both audit and non-audit fees. For example, Simunic (1984) has suggested that an explanation of his results could be that companies that purchased non-audit services from their auditors were firms experiencing unusual problems, motivating the purchase of non-audit services along with an abnormally large amount of auditing. Solomon (1990) extended the range of possible explanations, couched in terms other than of cost saving as a result of joint supply, to include: 'problem' firms may require a greater quantity of both audit and non-audit services; when non-audit services act as a mainspring to changes in the client's organisation, which in turn require greater audit effort; when there is lack of competition in the markets for the other services supplied; when audit partners are able to capture within the audit fee non-audit services fees for the purposes of internal profit calculation.

In this paper we are not seeking to directly test hypotheses relating specifically to any one of these competing explanations. Our concern in the empirical section of this paper is to determine whether the positive association reported in the majority of US and Australian studies exists in the rather different audit market conditions in the UK, and to seek to ascertain whether there are any strong interactive effects between non-audit services and other variables within the audit pricing model that may moderate any association between non-audit services fees and audit fees.

3. UK disclosures—some initial results

A problem that studies of the relationship between the level of audit fees and fees for non-audit services have to overcome is that of obtaining the relevant data. In the US there is no requirement for the disclosure of fees for either audit or non-audit services. There was a short-lived SEC requirement for disclosure of non-audit services fees as a percentage of audit fee, both in total and broken down for the principal categories of non-audit service (but no requirement for disclosure in absolute values). This requirement was introduced in 1978 but withdrawn three years later, apparently because of doubts about the value of the disclosure and concerns that it might distort the market for non-audit services (see Scheiner and Kiger, 1982; Scheiner, 1984).

Table 1
Frequency of Disclosure in 1992/93

Non-audit services fees disclosed (including one nil disclosure). 209 companies disclosed a comparative figure.	293
No disclosure of non-audit services fees	21
Total	314

3.1. UK Disclosure Requirements

In the UK, disclosure of the audit fee in the notes to the profit and loss account has been necessary for many years, but disclosure of fees paid for non-audit services was not required until introduced by statutory instrument in 1991.[5] Relevant aspects of this statutory disclosure requirement include the requirement for disclosure of remuneration of the company's auditors and their associates (as consultancy practices may be constituted as separate limited companies, this requirement is essential if disclosure is to be meaningful) and the requirement for disclosure of remuneration for services supplied to associated undertakings. The definition of an associated undertaking is given in the statutory instrument as any undertaking that is a subsidiary undertaking of the company 'other than a subsidiary undertaking formed under the law of a country or territory outside the United Kingdom'. There is also a specific exemption for providing comparative information for the first year of operation of the disclosure requirement, although, as noted below, the majority of companies did provide this information.

The exemption of disclosure of non-audit services provided for overseas subsidiaries is an important one, and one that has been criticised because failure to disclose this information may give an inappropriate impression of the relationship between the audit firm and the group as a whole. It is also conceivable that companies not wishing to disclose high levels of non-audit services fees might use overseas subsidiaries as a channel for these fees. The Cadbury Committee (1992) considered that the essential principle should be that the disclosure should enable the relative significance of the company's audit and non-audit fees to the audit firm to be assessed, both in a UK context and, where appropriate, in a worldwide context. It recommended (p. 39) that the regulations on the remuneration disclosure for non-audit work should be reviewed and amended as necessary in order to apply this principle.

3.2. Sample Selection

A sample of companies was randomly selected from the population of UK quoted companies identified from the 1992 *Quality of Markets: Companies Book*. This publication included a listing of all companies quoted on the London Exchange at 30 June 1992: 1,083 companies registered in the UK are listed in the commercial and industrial sectors. Every third company in that publication was selected, giving a sample of 361 companies. Financial statements were sought from these companies for accounting periods ending between 1 October 1992 (the date the requirement for the disclosure of non-audit services fees became effective) and 30 September 1993. Not all companies responded to the request for their financial statements, and this, together with the elimination of a handful of companies that were subsidiaries and of four companies that had joint auditors, resulted in a usable sample of 314 companies (≈87% of the initial sample).

3.3. Results Relating to the Nature of the Disclosures

As Table 1 shows, 21 companies did not report non-audit services fees for the period.[6] For none of these companies was it clear that non-audit services fees were nil, although for two companies this might be inferred from the fact that the disclosure note specified that the auditor's remuneration was in respect of audit services.[7] Non-disclosing companies were contacted to ascertain the reasons for the lack of disclosure, and the majority confirmed that non-audit services were either nil or so small as not to warrant separate disclosure.

For those companies disclosing remuneration for non-audit services (including one company that reported nil non-audit services fees), there were significant differences in the extent and nature of the disclosures made. Twenty-nine companies disclosed the amount of non-audit services remuneration outside the UK. Apart from these, 34 companies made some reference to the UK nature of the disclosed non-audit services fees. The nature of these references varied. Some specified that the disclosed non-audit services remuneration related to services to UK companies only. Others were worded in terms of payment to the auditors in the UK. It is possible that these payments included work in respect of overseas subsidiaries but which were billed centrally. Some disclosures made reference to the UK nature of the non-audit services fees in situations where, because there were no overseas subsidiaries, it was unlikely that there was any non-UK remuneration. For the majority of companies that did disclose non-UK remuneration, the amounts involved were significant. The non-audit services payments made by the 29 disclosers totalled £45,650,000, of which overseas remuneration amounted to £21,106,000 (one company paying £5,200,000 in respect of overseas non-audit services remuneration). The presence of such significantly high levels of non-audit fees lends some support to the Cadbury concerns over the adequacy of the current disclosure requirements.

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[5] This is not a unique requirement; there has been a requirement for disclosure of fees paid for 'other services' for many years in Australia, and all the Australian studies have used this disclosure for their basic data.

[6] Two companies that did not report any non-audit services remuneration in the relevant year subsequently reported the information as comparatives. These have been included in the sample on the basis of the disclosed comparatives.

[7] It is not clear from the wording of the statutory instrument that disclosure of nil figures is required, although this would normally be considered to be good practice.

Twenty-seven companies in the sample provided an indication of what the non-audit services entailed. The most frequently referred-to service was taxation (11 references). Others that appeared more than once included: accountancy assistance; work in association with share issues; work connected with acquisitions made; work in connection with the disposal of subsidiaries; and structural reorganisation. Fifteen companies referred to the capitalisation of some part of the non-audit services fees or, where connected with a share issue, the writing off of costs against a share premium account. All but three of these companies quantified the amount not charged to the profit and loss account. One company referred to an amount included within an extraordinary item. Disclosure of non-audit services fees was normally (but not always) contained within a note relating to operating profit before taxation.[8]

Although the detail of the disclosure was sparse, the aggregate figures set out in Table 2 below clearly confirm the importance of non-audit services provided to clients in generating fee income for audit firms. For the sample as a whole, total non-audit services fees amounted to 87% of total audit fees. Ninety-one (31% of the 293 companies reporting non-audit services fees in 1992–93) paid their auditors more for non-audit services than for the audit, and for 14 companies, non-audit services fees were at least three times the level of the audit fee. There was significant variation in the level of non-audit services fees, and there was also a difference between the overall proportion of non-audit services fees to audit fees for clients of Big Six firms and clients of non-Big Six firms. As Table 2 shows, this difference was more marked in 1992–93 than in 1991–92, even when comparison is made only for those firms disclosing the comparative figures.[9]

Two hundred and nine companies (71% of the 293 companies reporting non-audit services fees in 1992–93) disclosed comparative information although there was no specific requirement for such disclosure. Firms not voluntarily disclosing comparative figures were on average larger and more intensive users of non-audit services (using percentage of audit fees as a proxy for intensity). Separate screening of the proportion of non-audit services fees to audit fees by audit location, industrial classification and the existence or otherwise of non-UK subsidiaries, was undertaken. With respect to audit location there was no discernible difference between the London location (89%; n = 150) and the non-London location (86%; n = 143). Further, the sample was partitioned into five industrial groups: mineral extraction (n = 7); general manufacturing (n = 139); consumer goods (n = 35); services (n = 98); and utilities (n = 14) with the latter group (utilities or regulated) being significantly different from the other groups, with a non-audit services fee to audit fee ratio of 364% compared with a range of 70% to 84% for the remaining four industries. Although the sub-sample of utilities (electricity, water and telecommunications) is very small, the figures in Table 2 show that these companies are intensive users of non-audit services relative to their audit fees. Significant differences did occur between the groups with non-UK subsidiaries (81%) and those without non-UK subsidiaries (163%). While part of this difference may be attributable to the disclosed figure for non-audit services fees being restricted to UK paid non-audit services fees, the main reason appears to be the impact of the regulated firms. When these firms are excluded from the analysis, the revised figures are 73% and 100% for groups with and without non-UK subsidiaries respectively.[10]

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[8] There were, however, two instances where it was difficult to establish the total non-audit services fees figure on the basis of this disclosure. In one instance, a separate note headed 'due diligence costs' related to non-audit services fees, although these costs were referred to only as 'professional fees'. In another, non-audit services fees were separately included within an extraordinary item disclosure.

[9] It is also worth noting that, for the whole sample of companies disclosing comparative figures, a comparison between the 1992/93 and the 1991/92 figures reveals an increase of £2.7m (6%) in non-audit fees, whereas audit fees increased only by £0.6m (1%).

[10] It should be noted that, on average, groups with non-UK subsidiaries are approximately six times larger, in terms of sales, than groups without non-UK subsidiaries.

Table 2
Total Non-Audit Services Fees (£000s) as a Proportion of Total Audit Fees (£000s)

	1992/93	*1992/93**	*1991/92*
Big Six auditees	$\frac{94\ 113}{106\ 320}=89\%$ n=237	$\frac{45\ 280}{58\ 826}=77\%$ n=156	$\frac{42\ 781}{58\ 032}=74\%$ n=156
Non-Big Six auditees	$\frac{5\ 720}{8\ 283}=69\%$ n=77	$\frac{2\ 780}{4\ 182}=66\%$ n=53	$\frac{2\ 617}{4\ 352}=60\%$ n=53
All auditees	$\frac{99\ 833}{114\ 603}=87\%$ n=314	$\frac{48\ 060}{63\ 008}=76\%$ n=209	$\frac{45\ 398}{62\ 384}=73\%$ n=209
Regulated auditees**	$\frac{18\ 162}{4\ 994}=364\%$ n=14	$\frac{3\ 562}{1\ 931}=184\%$ n=8	$\frac{5\ 151}{2\ 031}=254\%$ n=8
Groups with non-UK subsidiaries	$\frac{86\ 758}{106\ 574}=81\%$ n=197	$\frac{42\ 674}{57\ 795}=74\%$ n=132	$\frac{40\ 359}{56\ 967}=71\%$ n=132
Groups without non-UK subsidiaries	$\frac{13\ 075}{8\ 029}=163\%$ n=117	$\frac{5\ 386}{5\ 213}=103\%$ n=77	$\frac{5\ 039}{5\ 417}=93\%$ n=77
Groups not disclosing breakdown of NAS	$\frac{85\ 269}{99\ 251}=86\%$ n=285	$\frac{44\ 090}{60\ 566}=73\%$ n=194	$\frac{42\ 370}{59\ 978}=71\%$ n=194
Groups disclosing breakdown of NAS	$\frac{14\ 564}{15\ 352}=95\%$ n=29	$\frac{3\ 970}{2\ 442}=163\%$ n=15	$\frac{3\ 028}{2\ 406}=126\%$ n=15

* For those disclosing comparative figures
**This is a subset of the total sample

4. Statistical analysis and multivariate results

4.1. The Basic Audit Fee Model

The overall association between the level of audit fees and that of non-audit services fees was initially tested using the basic model developed by Chan et al. (1993), with the introduction of an additional variable to distinguish between regulated and non-regulated companies.[11] This model is one of a family of models widely used in audit fee studies (for example, Palmrose, 1986b; Francis and Simon, 1987; Simon and Francis, 1988; Turpen, 1990) in which the dependent variable is the natural log of the company's audit fee and the key independent variable size (whether measured by assets or by turnover) is also logarithmically transformed.[12]

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[11] We have also followed the suggestion of one of the anonymous referees and subdivided the number of subsidiaries variable in the original Chan et al. model into separate variables for the number of UK and overseas subsidiaries in the model reported here.

[12] The Simunic (1984) model used as the dependent variable audit fees divided by the square root of total assets. However, he also tested other transformations, including a log/log model (log of audit fees as the dependent variable and log of total assets included within the control variables). He concluded that 'the basic results are invariant across alternative reasonable transformations and functional forms.'

Table 3
Description of the Variables

Variable	*Description*
LN(AF)	Natural log of audit fee as disclosed in the financial statements.
LNSALES	Natural log of turnover as disclosed in the financial statements.
ROCE	Return on capital employed (Datastream item 707).
DELAY	Interval between the end of the accounting period and the signing of the audit report measured in days.
HERF	Index of diversification based on Herfindahl (1950).
SIG	The proportion of the company's equity held by directors and 'significant shareholders'.
LOC	Coded 1 if the audit report has a London address, otherwise 0.
BIG6	Coded 1 if the auditor is a 'Big Six' firm, otherwise 0.
UKSUBS	Number of UK-registered subsidiaries as reported in the financial statements.
OSSUBS	Number of non-UK registered subsidiaries as reported in the financial statements.
REG	Coded 1 if the company is operating in a regulated industry (electricity, telecommunications, water).
NAS	Non-audit services fees as disclosed in the financial statements.
NROCE	Interactive variable NAS*ROCE.
NUKSUBS	Interactive variable NAS*UKSUBS.
NOSSUBS	Interactive variable NAS*OSSUBS.
NHERF	Interactive variable NAS*HERF.
NSIG	Interactive variable NAS*SIG.
NSALES	Interactive variable NAS*SALES.
NBIG6	Interactive variable NAS*BIG6.
NREG	Interactive variable NAS*REG.
NDELAY	Interactive variable NAS*DELAY.

The variables used in this study are set out in Table 3. The data for audit fee, the interval between the year end and the date of the audit report, segmental information, auditor location, auditor size, the number of UK and overseas subsidiaries, regulated industry, and non-audit services fee were derived from company financial statements. Data for turnover, return on capital employed, and significant shareholdings were obtained from Datastream.[13] The descriptive statistics for the variables used are contained in Appendix A.

4.1. *Results of the Basic Model*

The results obtained by running this model (with and without the new regulated industry variable) are shown as Models I and II in Table 4. When compared with the Chan et al. (1993) results (see Appendix B) they suggest that the basic model is quite robust in that the explanatory power remains high, and the coefficients of all the independent variables have similar signs and all the variables retain their significance, although that relating to significant shareholdings has fallen quite markedly. As can be seen in Model II, the regulated industry variable is strongly significant with a negative sign. Several explanations for this regulated industry effect exist. Some of the companies comprising this sub-sample were until recently in the public sector, and may have been subject to a different extent and ethos of accountability, control and audit. Furthermore, the majority of regulated enterprises operate with a limited product range and usually on a national rather than an international basis. For example, it may take less effort to audit a UK water company than a multinational manufacturer of a similar size. It is also possible that once privatised, the attractive opportunities for non-audit work suggested by the significantly high non-audit services fees to audit fees ratio reported in Table 2 may have influenced any adjustment to fees for normal private sector audit.

4.2. *The Impact of Non-audit Services Fees: Direct and Moderating Effects*

The next step was the introduction of non-audit services fees as an independent variable.[14] The results reported as Model III in Table 4 show that this variable has a positive coefficient and is highly

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[13] Datastream also provides data on audit fees, and a check was run against these data. This revealed a number of errors (10) in the Datastream data, in particular, the inclusion of non-audit services fees in the audit fee total, and in two cases the substitution of the figure for directors' fees for the audit fee figure.

[14] The nature of any joint product effect (or competing explanation) may be lagged. This possibility was tested by replacing NAS with the variable NASt-1 (the level of non-audit services fees in the previous year). However, this substitution did not change the results for the 209 companies for which comparative data were available.

Table 4
Regression Results

	Model I	*Model II*	*Model III*	*Model IV*
Dependent variable	*LN(AF)*	*LN(AF)*	*LN(AF)*	*LN(AF)*
n	*294*	*294*	*294*	*294*
LNSALES	0.4471 _15.25_**	0.4781 _20.46_**	0.4477 _18.15_**	0.4064 _16.39_**
ROCE	−0.0005 _−2.461_**	−0.0005 _−1.676_*	−0.0005 _−1.728_*	−0.0006 −2.039*
DELAY	0.0029 _2.935_**	0.0027 _2.724_**	0.0027 _2.775_**	0.0015 1.478
HERF	−0.8073 _−6.966_**	−0.8018 _−7.286_**	−0.7929 _−7.333_**	−0.7772 _−6.669_**
SIG	−0.0028 _−1.717_*	−0.0035 _−2.311_*	−0.0041 _−2.671_**	−0.0033 _−2.143_*
LOC	0.3940 _6.562_**	0.3695 _6.415_**	0.3556 _6.269_**	0.3175 _5.747_**
BIG6	0.2110 _3.318_**	0.2296 _3.547_**	0.2329 _3.664_**	0.2829 4.288**
UKSUBS	0.0131 _3.292_**	0.0101 _2.523_**	0.0095 _2.401_**	0.0164 _3.498_**
OSSUBS	0.0179 _4.241_**	0.0149 _6.332_**	0.0141 _6.043_**	0.0195 _7.208_**
NAS	n/a	n/a	0.0001 _3.370_**	0.0005 _1.245_
REG	n/a	−0.7449 _−5.358_**	−0.8292 _−5.973_**	−0.7261 −4.542**
NROCE	n/a	n/a	n/a	−0.760E−6 _−1.241_
NUKSUBS	n/a	n/a	n/a	−0.627E−05 −2.172*
NOSSUBS	n/a	n/a	n/a	−0.921E−05 _−4.186_**
NHERF	n/a	n/a	n/a	0.0003 1.582
NSIG	n/a	n/a	n/a	−0.104E−05 _−0.3741_
NSALES	n/a	n/a	n/a	0.175E−10 _1.502_
NBIG6	n/a	n/a	n/a	−0.0006 _−2.247_*
NREG	n/a	n/a	n/a	−0.0003 _−2.361_*
NDELAY	n/a	n/a	n/a	0.502E−05 _1.677_
CONSTANT	−0.3808 _−0.9305_	−0.6454 _−1.872_	−0.2975 _−0.8395_	0.0833 _0.2320_
Adjusted R²	0.8752	0.8863	0.8903	0.899
Jarque-Bera	1.5308(2)	0.0660(2)	0.7760(2)	1.7918(2)
Breusch-Pagan	17.941(9)	13.618(10)	14.55011)	49.0209(20)**

Figures in italics are t-statistics: *Significant at 5% level; **Significant at 1% level or higher.

significant, suggesting that the positive association between the level of audit fees and the level of non-audit services fees that has been detected in both the US and Australia also exists in the UK.

As noted above, a number of explanations have been advanced to explain this positive association. The introduction of interactive terms into the basic model is for the purpose of shedding more light on the complexity of the relationship between audit and non-audit services fees. Although the rationale underlying the use of multiplicative interactive terms is well documented (for example, Jaccard, Turrisi and Wan, 1990), there have been few previous attempts to incorporate them into research on non-audit services fees.

4.3. Interactive Variables

The development of specific hypotheses for the manner in which interactions between non-audit services and other variables affect the level of audit fee is problematic. There is no existing consensus on the theoretical underpinning of the positive association between audit fees and fees for non-audit services, with some of the arguments put forward being contested by other researchers.[15] The problem is compounded by the variety of activities comprising non-audit services and the possibility that there are different interactions depending on the nature of the non-audit service provided. The nature of the relationship is likely to be different as and between taxation advice, installation of financial control systems, corporate finance services, and so on. The UK disclosure requirement does not call for the non-audit services fees figure to be disaggregated into its component parts and, as noted in Section 3 above, only a few companies disclosed disaggregated data on a voluntary basis. Nor is there an existing body of empirical literature to act as a guide. Simunic (1984) did introduce interactive terms into a set of multivariate regressions, but found that the only statistically significant interactions were those between complexity measures and a dummy variable proxying the presence of management advisory services fees within his large client sub-sample. Simunic suggested that this might indicate greater knowledge spillovers when a large auditee is a complex corporate entity.[16]

We use nine interactive terms linking levels of non-audit services fees and proxies for client profitability, audit complexity, agency costs, audit firm size, regulated industry and audit delay. The choice of these proxies for the interactive terms was based on the belief that each could have a significant moderating effect on the relationship between non-audit services fees and audit fees. Thus, NROCE investigates the interrelationship between profitability and non-audit services fees and its effect on audit fee levels. If the nature of the non-audit services purchased changes with the level of auditee profitability, and if different types of non-audit services have different levels of spillover effect on the audit, then one would expect this term to be significant.

The terms NUKSUBS, NOSSUBS and NHERF examine the potential relationship between proxies for audit complexity and the level of non-audit services fees on audit fees. It could be argued that these aspects of client complexity are likely to affect the level of audit fees either through knowledge spillover or by stimulating greater demand for both audit and non-audit services. The two terms NSIG and NSALES seek to capture agency-related aspects to the interactions. Antle (1984) develops an audit model that demonstrates that where management and auditor remuneration is a function of their respective reports, then there are incentives for management and auditor to engage in co-operative behaviour or even direct collusion (involving side payments). He suggests that in such circumstances the existence of non-audit services contracts might act as a convenient camouflage for such side payments, which could lead to inflated non-audit services fees. Both significant shareholdings and sales may be used as proxies for agency variables. The nature of the non-audit services provided is likely to vary with the type of audit firm engaged as, typically, the Big Six firms are more likely to provide consultancy services than smaller audit firms, whose focus is likely to be directed to taxation and accountancy services.[17] Hence the interactive term NBIG6 was constructed.

Although the number of companies operating in regulated industries in the sample is small (14 in total), the highly significant negative coefficient of this variable in the basic fee model, together with the strikingly high ratio of non-audit service fees to audit fees evidenced in Table 2, suggests the likelihood of a significant interactive effect. The knowledge spillover, the desire by auditors to win lucrative non-audit services contracts, and given their recent privatisation, potential increased demand for both audit and non-audit work, may affect the level of audit fees. Hence, we have constructed the interactive term NREG. Finally, audit delay was found to be significant in the basic model, and it may be capturing aspects of the auditor-auditee relationship not picked up elsewhere in the model, for example, in terms of audit risk, auditor client negotiation time, audit time pressure, etc. To allow for this potential effect, the interactive term NDELAY was constructed. For each of these interactive terms, there are forces that could potentially operate on the level of audit fees in opposing directions.[18]

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[15] For example Abdel-khalik (1990) argues that the expectation of any positive association is counter intuitive in that if there is a positive link, the two products would be purchased separately. He noted that 'it is difficult to think of economic incentives that could exist a priori for clients to pay more for the joint acquisition of two products than for the sum of acquiring them separately' (at p. 318). Though, as one of the referees has pointed out, this quote does appear to ignore the beneficial spillover/substitution between external and internal audit arguments outlined above.

[16] Although there was a statistically significant interaction with management advisory services as a zero-one variable, there was none when it was included, deflated by the square root of assets, as a continuous variable.

[17] This is borne out by figures for 1993–94, which show that whereas the six largest firms and the next six largest UK firms derived a similar percentage of their overall fee income from taxation work (on average 23% and 26% respectively), there was a striking difference in the proportion of overall fee income derived from consultancy (on average 26% and 5% respectively). (*Accountancy*, July 1994: 15.)

4.4. Regression Diagnostics

For each of the four models reported in Table 4, the null hypothesis of normally distributed regression residuals cannot be rejected at the 5% significance level. The test statistic, Jarque-Bera (1985), is reported for each model in Table 4. Auxiliary regressions were used in examining the extent of multicollinearity (see Appendix C). Auxiliary regressions with 'high' R^2s indicate potentially serious levels of multicollinearity. While there is no formal definition of a 'high' R^2, Kennedy (1992: 183) suggests that a value equal to, or in excess of, 0.9 indicates a serious level of multicollinearity. On this basis none of the models I through III exhibits potentially serious levels of multicollinearity. The situation changes when the interactive terms are introduced. This is not in itself surprising as potentially serious levels of multicollinearity are inherent in using interactive terms (Jaccard, Turrisi and Wan, 1990) and this is reflected in the auxiliary regression R^2s in excess of 0.9 for the variable measuring non-audit services fees NAS, and four of the interactive terms: NHERF, NSALES, NBIG6 and NDELAY. The use of condition indices also suggests potential problems with multicollinearity as six condition indices exceed 10, the level below which the dependencies can be termed 'weak' (Belsley et al., 1980: 105). The possibility that the significance tests are affected by multicollinearity must then be borne in mind in evaluating the results reported below. However, the results obtained when the model is run with centred data suggest that the effect of this multicollinearity is to weaken the power of the statistical tests rather than to invalidate the basic results.[19]

The degree of heteroscedasticity was assessed using the Breusch-Pagan test statistic (Breusch-Pagan, 1979). Only for Model IV was the assumption of homoscedasticity rejected at the 5% significance level. Consequently, the reported t-statistics for this model have been adjusted using the White method (White, 1980).

4.5. Moderating Effects

The results of incorporating the interactive terms into the model are reported in Model IV, Table 4. This shows that four of the nine interactive terms introduced in the augmented audit fee model are statistically significant at least at the 5% level of significance (for a two-tailed test).[20] These results do suggest that there are indirect effects as non-audit services fees moderate the association between explanatory variables and the audit fee.

As suggested earlier, we could not on an a priori basis hypothesise a directional effect for any of the interaction terms we introduced. Nevertheless, it is interesting to note that all four significant interaction terms have negative coefficients, which seems to suggest that in the main there are valuable knowledge spillover effects in the case of these terms which, assuming the demand for audit is price-inelastic, results in a lower audit fee. This clearly does not suggest the complete absence of factors operating in the reverse direction; to the extent that these other factors are present, knowledge spillovers are sufficiently large to more than offset them. Thus, the significant negative coefficients for NUKSUBS and NOSSUBS suggest that higher levels of non-audit services and greater auditee complexity (as proxied by numbers of UK and overseas subsidiaries) are associated with reductions in audit fees stemming from beneficial knowledge spillovers. Performing non-audit services for clients characterised by higher levels of complexity could be demanding, both in terms of scope and scale of services, and this would be reflected in higher levels of non-audit services fees. But as such knowledge is accumulated, the audit firm is able to use it to inform its audit work for the same client, and in this case the beneficial spillover effects pass from non-audit services to audit work.

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[18] Consider, for example, the potential effect of NDELAY on the level of audit fees. Audit work may reveal that more non-audit services work is needed to improve internal control, and thus in a given year the client may pay high audit *and* non-audit services fees, as the benefits from the investment in non-audit services may only materialise in future years. Alternatively, expenditures on non-audit services may reduce the level of audit risk, thereby enabling lower audit fees to be charged.

[19] Centring the data (Cronbach, 1987) prior to the calculation of the interactive terms had a significant impact in terms of reducing the potential for multicollinearity. All the auxiliary R^2s with one exception were reduced to or below 0.9, and none of the condition indices exceeded 10. The use of centred data resulted in increasing the significance of certain of the variables—most notably non-audit services—and three more of the interactive terms NROCE (which was previously insignificant and of opposite sign), NUKSUBS and NBIG6 became significant at the 1% level. The only variable to lose significance from the 1% level (to the 5% level) was BIG6. Full results for the centred data are available from the authors on request.

[20] If, as suggested by one of the anonymous referees, the 14 regulated companies are excluded from the sample and Model IV re-estimated, the following changes occur: NROCE and NHERF are both significant at the 1% level and NUKSUBS ceases to be significant. These companies are on average high users of non-audit services (see Table 2), but these results suggest that their inclusion/exclusion does not change the majority of the conclusions that can be drawn.

In the case of NBIG6, the significant negative coefficient can be explained both in terms of beneficial knowledge spillover and 'low-balling'. As the Big Six firms may be able to provide more pure consultancy services in comparison with smaller audit firms, pure consultancy work may offer the potential for a better understanding of the client's operations, which could then be reflected in beneficial knowledge spillover from consultancy to audit work. Moreover, the scope and scale of non-audit services for the Big Six audit firms tend to be substantial. In such cases it is easier for a Big Six audit firm, compared with a smaller firm, to price audit work below cost and recoup that loss by charging higher non-audit services fees. Thus, large audit firms may be more prepared to take account of potential returns on non-audit services in the pricing of their audit product. This argument clearly presupposes that the demand for non-audit services supplied by the Big Six firms is less sensitive to price variations compared with the case of smaller audit firms.

Arguments similar to those above are applicable to the remaining significant interaction term NREG. The lucrative non-audit services work demanded by recently privatised clients provides a very strong incentive for audit firms to reduce audit fees in order to secure non-audit services work; the scope for making up for any loss in audit fees by over-charging for non-audit services is far greater in this case than in the rest of the sample. Moreover, with such extensive non-audit services, there is significant scope for beneficial knowledge spillover from non-audit services to audit work.[21]

It is difficult to explain satisfactorily the loss of significance associated with the variable NAS when the interactive terms are introduced. If the significant interactive terms are capturing knowledge spillovers one would expect the remaining effects captured by the variable NAS to have a stronger rather than weaker association with the level of audit fees. However, the presence of multicollinearity may be relevant here. Interpretation of the results for the remaining non-significant interactions is also difficult. It is possible to dismiss them as unimportant by suggesting that they have no serious impact on the determination of audit fees. It is also possible that their lack of significance is caused by cancelling out of the combined effects of beneficial knowledge spillover and factors that may push audit fees up (for example, joint increase in audit and non-audit services fees). We are unable to segregate these separate effects in our research design.

5. Discussion and conclusions

The study reported in this paper had three objectives: (i) to report on the extent and nature of the provision of non-audit services to audit clients in the UK; (ii) to ascertain whether or not the positive association between fees for audit and for non-audit services observed in certain US and Australian studies holds for the UK; and (iii) to explore the relationship between the pricing of audit and non-audit services by examining the manner in which other explanatory factors may moderate the associations between non-audit services fees and audit fees.

The evidence of the study is that non-audit work for large audit clients provides a major source of income for audit firms, amounting, for the sample investigated, to as much as 87% of total audit fees in 1992/93. This does suggest that the provision of non-audit services to audit clients comprises the major proportion of the provision of non-audit services by the major firms, and does little to allay the concerns expressed by academics and policy-makers on the question of auditor independence. A degree of sensitivity over the extent of this provision may be inferred by the finding that those firms voluntarily disclosing comparative figures had a lower ratio of non-audit services fees to audit fees than that of the sample as a whole. A final point on the disclosures is the lack of clarity with regard to the disclosure of non-UK non-audit services remuneration. This lends support to the Cadbury concerns over the adequacy of the current disclosure requirements. However, our analysis suggests that the differences between firms with and without non-UK subsidiaries are largely explicable in terms of the effect of the inclusion of regulated firms. When regulated firms are excluded from the sample, the differences are much less marked and, as pointed out earlier (see footnote 20), the paper's general conclusions do not change.

The evidence also points firmly to the existence in the UK for quoted companies at least of a positive association between fees paid by companies for non-audit services and those for audit services. This finding is consistent with the findings of the majority of US and Australian studies, for example, Simunic (1984); Simon (1985); Palmrose

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[21] A further complication lies in the need for specific reports to be made to regulatory agencies, and the arbitrary nature of classification of these as and between audit and non-audit services.

(1986a); and Turpen (1990). There are, as noted above, a variety of competing explanations for this observed phenomenon. We have not attempted to test directly for any one of these in this study, but we have explored certain of the interactions between the provision of non-audit services and certain other variables that have been found to have significance in audit pricing studies. Here, the results reported above suggest that interrelationships and interactions do exist and may be worthy of further investigation.

There are a number of possible ways in which further research in this field could develop, and we conclude by identifying certain avenues that seem to us to offer potential for improving and expanding on the work carried out to date. First, the non-audit services fees variable used here is far from homogeneous, and it is possible that different components of the non-audit services fees could impact, both directly and indirectly, on audit fees. Future research could solicit information from audit clients with a breakdown of these components to test the individual effects on audit fees. It would also be revealing to interview both auditors and auditees to obtain a deeper understanding of the actual links between audit and non-audit services in practice.

Here one specific question of interest would be the extent to which the ability of an audit firm to provide non-audit services influences the client choice of auditor. Second, future research could examine the association between levels of non-audit services fees paid by audit clients and the length of audit tenure, as well as the propensity of the audit client to be issued with a qualified audit report. Findings of this nature should shed further light on the problematic issue of auditor independence. Third, more attention could be devoted in future research to modelling the moderating relationship between non-audit services fees and audit fees, with the possibility of experimenting with new variables additional to those examined here. One approach would be to extend in a UK setting the work of Davis et al. (1993) by examining audit firms' internal records of audit and non-audit services effort by client. Finally, the negative coefficient for the regulated variable and the unusually high proportion of non-audit to audit fees suggest that recently privatised industries provide an intriguing setting for examining further the market for audit and non-audit services.

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Appendices

Appendix A
Descriptive Statistics

VARIABLE	*MEAN*	*ST. DEV.*	*MIN.*	*MAX.*
AF	386,711	807,227	8,000	6,000,000
LN(AF)	11.828	1.316	8.987	15.607
NAS	367,959	970,289	2,000	7,800,000
SALES	7.23E+8	2.06E+9	1,265,000	1.60E+10
LN(SALES)	18.539	1.83	14.05	23.496
ROCE	12.258	83.318	−259.11	1,168.7
DELAY	92.228	28.654	32.00	250.00
HERF	0.721	0.271	0.22	1.00
SIG	48.273	22.949	0.26	100.00
LOC	0.51		0.00	1.00
BIG6	0.772		0.00	1.00
UKSUBS	8.078	7.628	0.00	64
OSSUBS	6.714	13.506	0.00	115.00
REG	0.044		0.00	1.00
NROCE	2.03E+6	5.31E+7	−8.3E+8	2.27E+8
NUKSUBS	4.53E+6	1.859E+7	0.00	2.13E+8
NOSSUBS	6.275E+6	2.835E+7	0.00	3.51E+8
NHERF	210,492	582,447	2,000	6.47E+6
NSIG	1.265E+7	3.181E+7	32,800	2.45E+8
NSALES	1.87E+15	1.01E+16	6.11E+9	1.25E+17
NBIG6	343,227	972,444	0.00	7.8E+6
NREG	55,027	568,517	0.00	7.8E+6
NDELAY	2.869E+7	6.912E+7	156,000	5.93E+8

Appendix B
Summary of Chan et al. Model

Dependent variable	*LN(AF)*
n	*280*
LNSALES	0.4807
	*13.598***
ROCE	−0.0052
	*−2.403**
DELAY	0.0213
	*2.524**
HERF	−0.4743
	*−4.143***
SIG	−0.0051
	*−3.116***
LOC	0.3037
	*4.557***
BIG6	0.3126
	*4.806***
NUMBER OF SUBS	0.0172 *4.095***
CONSTANT	−1.2214
	*−3.267***
Adjusted R^2	0.87

Figures in italics are t-statistics:
* Significant at 5% level;
**Significant at 1% level.

Appendix C
Auxiliary Regressions

	MODEL I	*MODEL II*	*MODEL III*	*MODEL IV*
R-SQUARE OF LNSALES	0.60	0.63	0.68	0.71
R-SQUARE OF ROCE	0.02	0.02	0.02	0.12
R-SQUARE OF DELAY	0.17	0.17	0.17	0.33
R-SQUARE OF HERF	0.24	0.24	0.24	0.40
R-SQUARE OF SIG	0.44	0.44	0.44	0.53
R-SQUARE OF LOC	0.18	0.19	0.19	0.21
R-SQUARE OF BIG6	0.08	0.09	0.09	0.23
R-SQUARE OF UKSUBS	0.27	0.28	0.28	0.54
R-SQUARE OF OSSUBS	0.30	0.34	0.34	0.56
R-SQUARE OF NAS	n/a	n/a	0.38	0.99
R-SQUARE OF REG	n/a	0.18	0.20	0.45
R-SQUARE OF NROCE	n/a	n/a	n/a	0.53
R-SQUARE OF NUKSUBS	n/a	n/a	n/a	0.79
R-SQUARE OF NOSSUBS	n/a	n/a	n/a	0.85
R-SQUARE OF NHERF	n/a	n/a	n/a	0.93
R-SQUARE OF NSIG	n/a	n/a	n/a	0.88
R-SQUARE OF NSALES	n/a	n/a	n/a	0.91
R-SQUARE OF NBIG6	n/a	n/a	n/a	0.99
R-SQUARE OF NREG	n/a	n/a	n/a	0.83
R-SQUARE OF NDELAY	n/a	n/a	n/a	0.98

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Optimal Disbursement of a Sunk Resource and Decentralised Cost Allocation

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Abstract—We consider whether the allocation of the sunk cost of a central resource to operating divisions can be consistent with economically optimal resource consumption decisions. When it is recognised that the central resource is scarce, one may, in principle, defend the allocation of sunk cost, if it measures the opportunity cost of usage. However, typically it has been proposed that such allocations are, at best, a proxy for opportunity cost. Applying classical control theory techniques in a wide range of operating environments, we are able to identify cost allocations that exactly equal opportunity cost. Hence, for our model environment, we provide a rationale for sunk cost allocation in terms of guiding *optimal* decisions, in contrast to the traditional defence in terms of providing a *proxy* for opportunity cost. We demonstrate clearly how cost allocations are related to opportunity costs, and identify the circumstances under which the allocation of full costs or alternatively a fixed proportion (related to acquisition conditions) of costs, results in the implementation of economically optimal resource consumption decisions.

1. Introduction

Miller and Buckman (1987) have demonstrated that the ubiquitous use by businesses of sunk (capacity) cost allocation practices can be rationalised when such allocations are a good proxy for hard-to-determine opportunity costs. Assuming a queuing theoretic model with s servers and fixed coefficient a, they argue that 'When the cost of capacity is of the form $C(s)=as^{\alpha}$ and α is close to one, we show that allocated fixed costs are a good proxy for average opportunity costs. However, if there are great economies of scale (α is close to zero), then a method which charges users only for the variable costs of the service department is recommended.' In order to concentrate on the link between opportunity costs associated with capacity provision and cost allocation they (p. 628) required that '...no queue is permitted. When a request arrives and all s servers are busy, the request is either dropped or satisfied externally'. Dewan and Mendelson (1990: 1,503) relaxed this assumption by allowing a queue to build up and hence introducing an additional 'Opportunity cost of a different nature...related to timeliness, which is an important attribute of service quality.' They show that, in such an environment, full sunk cost recovery is sub-optimal, and identify the recovery rate consistent with optimising behaviour. Related work by Balachandran and Srinidhi (1987) has shown that cost recovery should exceed the sunk cost in order to induce optimal utilisation of such a service facility.

When considering the utilisation of a service department's scarce capacity, such as computing support, the queuing theory-based modelling approach, adopted by the above researchers, seems most appropriate. However, for a wide range of allocation problems, the setting is quite different (see Hughes and Scheiner, 1980 for instance). At the beginning of a period, an operating division is either centrally allocated, or alternatively withdraws, in a decentralised fashion, a fixed amount of some scarce resource. Once this decision is taken, the division then has exclusive (private) use of the resource for the period, unlike the classic queuing model. We apply the optimal control theory to such resource problems[1], and investigate the extent to which sunk cost allocations can guide management to make economically-optimal decisions.

Following the above authors, we investigate the rationale for sunk cost allocation practices, and consider the optimality of full-cost allocation practices. Rather than argue that sunk cost allocations are good *proxies* for opportunity cost, we are able in our model to demonstrate *precise equivalence* and moreover derive *exact* statements concerning optimality of sunk cost allocation. We establish that it is necessary to weight the (sunk) cost of provision of the scarce corporate resource by the scale factor α; then, allocating this proportion of the sunk cost in a prescribed manner guides management to take optimal decentralised decisions concerning the scarce corporate resource's utilisation. We establish simple intuitive rules that provide a clear rationale for the use of sunk cost allocation practices.

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[1] At a more technical level, the difference between these models is that the queuing theoretic approach models the stochastic process as a Poisson process, whereas we use the Weiner process (Brownian motion). See a standard text on probability models, such as Ross (1989), for a more detailed discussion of these processes.

A second concern when attempting to establish a rationale for sunk cost allocation practices has been clearly articulated by Hughes (1993: 661). He argues that if one needs to 'solve the problem to demonstrate the accounting practices are consistent with optimal decisions, clearly the practices themselves are not needed to determine the decisions'. That is, any attempt to argue that sunk cost allocation is a decentralised means of affecting economically-optimal allocation of sunk resources is purely illusory if one first needs to determine the scarce sunk resource's optimal centralised physical allocation. Our coverage of this issue commences in the second section. We demonstrate that one does not need first to solve the centralised problem to determine the cost allocations required to guide decentralised economically optimal decision-making. Our most general statement of this result is provided in the section by Observation 1.

In this introductory section we have given a very brief overview of our results. However, since there is a large related literature on the subject of cost allocation, we devote the next section to a more detailed discussion of it. In Section 3, we present the single period (instantaneous) resource problem in order to establish the basic formal language and the equivalence of optimal physical disbursion with optimal internal price disbursion, via the Lagrangian multiplier; this is true at any instant/period of a multiperiod model on which we will thereafter concentrate. In Section 4, we develop the deterministic dynamic resource problem, and in Sections 5 and 6 we consider stochastic dynamic resource problems. Whereas the nature of opportunity costs in the deterministic models is highly stylised, we observe that the stochastic models introduce a wealth of (more realistic) complexity while maintaining sufficient structure to allow meaningful analysis.

In Section 7, we present a theorem utilising Hölder's inequality, which confirms our initial intuition that even in an uncertain environment the optimal strategy will use all of the sunk resource, though at any intermediate time there will be some holding back of resource, in the hope of more favourable future operating conditions; Hölder's inequality shows that a certain deterministic proportion of the stock remaining will always be committed at any time. For finite horizon planning, this certain proportion grows inversely with time to expiry. In Section 8 we present concluding comments.

2. Related literature

A multiplicity of methodologies exist for constructing mathematical models of the allocation of costs in organizations. Historically, the two predominant methodologies have been the queuing and the principal agent incentive modelling approaches. We shall now review these respective approaches and more recent models that combine the two.

As long ago as Devine (1950), the accounting literature has recognised the need for congestion costs in service facilities to be taken into account when considering capacity planning and utilisation decisions. In an informal debate, Leeman (1964, 1965) and Saaty (1965) considered the desirability of charging a toll to arriving product orders to take account of such congestion costs. The first mathematical model to formally incorporate these considerations was the queuing model of Naor (1969), which modelled the service facility as a single server queue with Poisson arrivals, exponential service times and a homogenous population of customers. The optimal toll derived by Naor ensured that the privately-motivated entry to the congested service facility was restricted in order to maximise the public good. It is obvious that in reality the practice of charging a toll to arriving orders could be implemented by a cost accounting system. Thus, Naor's formal results were potentially of great importance to accounting theorists who wished to understand why firms used practices such as absorption costing, which charged more than variable costs to production. This arises because if the allocated fixed cost component of absorption costs were equal or at least a good proxy to the congestion cost, a clear economic rationale for the practice of full cost allocation would exist. With this consideration in mind, we shall now consider how Naor's model has been extended in several directions, more recently with cost allocation practices explicitly in mind.

A first set of researchers extended Naor's results concerning the potential conflict between private and public optimal admittance to the service facility by applying the methodology to more complex queuing environments. Knudsen (1972) extended Naor's model by introducing multiple servers and revised reward structures. Littlechild (1974) and Balachandran and Schaefer (1979) further generalised the earlier results by introducing uncertainty over the service facility's current status. The first authors to formally apply the idea of modelling cost allocation practices as equivalent to charging a congestion cost toll in a queue were Balachandran and Srinidhi (1987 and 1988). Related work by Miller and Buckman (1987) focused on facility choice decisions, relating cost allocation practices to capacity costs when no queues were allowed. Adopting a unifying approach, Balachandran and

Srinidhi (1990) introduced capacity cost considerations into their original framework and showed that 'the opportunity costs and transfer charges on the users to effect optimal utilisation are equal' (p. 579), thus providing a clear rationale for cost allocation practices as measures of opportunity cost. Their model also considered the sensitivity of allocation practices to subsequent variation in the value of parameters. This type of variation is interesting for cost accountants, since such results can formally be interpreted as the practice of accumulating overhead volume variances (see also Gietzmann and Monahan (1996)).

All the above models were based on the premise that hard-to-calculate congestion (opportunity) costs can be determined or at least proxied by a cost accounting system. However, another stream of research originally commenced by assuming that cost allocation practices were only valuable if they provided useful information for incentive contracting purposes. For instance, Whang (1989) considers how cost allocation practices may be useful in providing incentives for revelation of privately held demand information, while Balakrishnan and DeJong (1993) focus on the revelation of privately-held information concerning management skill. In a similar way, Rajan (1992) explores the possible role of cost allocation practices in incentive contracting when multiple agents exist. All these models study how cost allocation practices may be useful in designing an ex ante incentive mechanism for the revelation of privately-held information. Implicitly, they assume that issues such as the calculation of opportunity costs are somewhat trivial, since they are static single period models in which the opportunity cost of usage is determined when the resource is purchased, and hence there is no need to subsequently redetermine by some other means (such as cost allocation) what the opportunity cost is To reiterate, in these models the central issue is, how can the resource purchaser provide subordinates with suitable incentives so that they non-strategically reveal valuable private information that is required to make the correct purchase decision?

There are at least two reasons why some of the above incentive models see no value in attempts to calculate opportunity costs after the resource has been purchased. This arises because they model the problem both within an essentially static and deterministic setting in which opportunity costs and allocations would never change through time. Thus it is not surprising that they find no role for cost allocation practices to determine how opportunity costs vary through time or with (activity) congestion levels. The first attempt to relax these restrictive assumptions were the models developed by Radhakrishnan and Balachandran (1992 and 1995), which extend the application of deterministic incentive contracting models to a (non-deterministic) queuing framework. In their models, they determine an optimal cost application that is made up of two components. One component comprises the congestion cost and the other an incentive cost to discourage greedy behaviour. Their results are hence very useful for understanding how cost application methods can be structured in order to deal with the dual problems of charging for varying congestion costs, and also how to control incentives for the provision of productive acts.

In the model we develop, we further explicitly consider issues that arise when in addition to stochastic realisations of parameters, the decision-making problem is dynamic. Our chosen model structure is based on a classic micro-economic model of the firm with a short-term constrained resource rather than as a queuing problem. In the following section we shall first set up our model and then at the end of the section compare our chosen model structure to that of the recent work by Radhakrishnan and Balachandran. As we shall see in the stochastic dynamic model that we will develop, the ongoing determination of opportunity costs is not trivial, as it is in static deterministic incentive-contracting models. We thus abstract from incentive-contracting issues, not because they are unimportant, but instead because we propose that the non-trivial determination of time-varying opportunity costs, and the role cost allocation can play in this, is a precursor to developing incentive-contracting models in the stochastic dynamic setting, which, we propose, more realistically captures actual decision-making processes. We shall now briefly review the static case to establish notation, and aid development of intuition for the more realistic dynamic models.

3. Static disbursion model

Assume a central headquarters purchases a resource X at a cost of X^{α}, $\alpha > 0$. Once purchased, the resource level is fixed for the production period, at a level denoted $\overline{X}$. We assume that it is fixed because it would be very costly to change the level available for use in the current production period. The resource needs to be disbursed to n divisions indexed $i = 1,2,\ldots, n$. Each division produces one product, so there is no inconsistency in referring to i as indexing division i or alternatively product i. In order to characterise the divisions' operating environment, we choose the standard micro-economic production function of the form:

$$j_i(x_i,\theta_i) = \theta_i x_i^{\beta} \tag{1}$$

where x_i denotes the physical amount of the centrally provided resource used to manufacture division i's product. This form is particularly tractable, and we leave as an open question for further research what other forms of production functions will also satisfy our derived optimal disbursal policies. We require that $\beta < 1$, so that the quantity of product i that is produced is concave in x_i. We assume θ_i is a technology scaling factor. Let c_i be the unit contribution margin for the i'th product, which is retailed in a perfectly competitive market (as c_i is the contribution margin, it does not include any cost for use of X). By setting $a_i = c_i\theta_i$ we can express the divisions' return functions (aggregate contributions) as $a_i x_i^\beta$ for $i = 1,2,..., n$. For the moment, we will assume that at the time when allocations need to be determined, a_i for $i = 1,2,..., n$ is publicly known (with certainty). We will relax this assumption in Sections 4 and 5 and assume that the a_i's evolve stochastically. At this stage it is worth emphasising that when comparing divisions, it is important to note that differences in respective a_i values can arise from differential market price or variable cost conditions via c_i, or alternatively through differences in production technology via the θ_i term.

3.1. *Centralised Physical Disbursion Mechanism*

We commence by assuming that after determining $\overline{X}$, the centre observes the realisation vector $a = (a_1, a_2,..., a_n)$. On the basis of this observation, knowledge of the divisional production technologies and $\overline{X}$, the centre chooses the optimal disbursement vector $x^* = (x_1^*, x_2^*, \ldots, x_n^*)$ according to the following mathematical program:

$$x^* = \arg\max_{x} \Sigma_{i=1}^n a_i x_i^\beta, \tag{2}$$

$$\text{s.t. } \sum_{i=1}^n x_i \leq \overline{X}.$$

Then with

$$\gamma_i = a_i^{\frac{1}{1-\beta}} \tag{3}$$

and

$$\gamma = \sum_{i=1}^n \gamma_i \tag{4}$$

a routine calculation shows that the optimal solution (physical disbursement of the central resource) takes the form:

$$x_i^* = \frac{\gamma_i}{\gamma}\overline{X} \ \forall_i \in \{1, 2,..., n\}. \tag{5}$$

Thus the disbursion rule for this problem has a simple economic intuition; each division receives a proportion $\frac{\gamma_i}{\gamma}$ of the centrally provided resource (i.e. clearly, $\sum_{i=1}^n \frac{\gamma_i}{\gamma} = 1$). Furthermore, the higher the contribution margin of the i'th division's product and/or the greater the productivity of the division's production process, the larger γ_i, and hence the greater the proportionate share of the central resource disbursed to that division. Although it is intuitive, we should note that the above optimal rule would become considerably more complex if, in general, divisions i and j operated with $\beta_i \neq \beta_j$.

With hindsight, we now choose to use a revised form of notation that will subsequently be shown to be particularly helpful in understanding the generality of the results. If we let

$$s = \frac{1}{1-\beta} \tag{6}$$

and set $\beta = \frac{1}{r}$, then we note that r and s are dual variables connected by the equation

$$\frac{1}{r} + \frac{1}{s} = 1. \tag{7}$$

This familiar and useful mathematical duality will be exploited, via application of Hölder's inequality, in our stochastic approach, particularly in Section 6. For the present context the inequality reads

$$\sum_i a_i x_i^\beta \leq \left(\sum_i (x_i^\beta)^r\right)^{\frac{1}{r}} \left(\sum_i a_i^s\right)^{\frac{1}{s}} \leq \overline{X}^{\frac{1}{r}} \left(\sum_i a_i^s\right)^{\frac{1}{s}} \tag{8}$$

and so gives an important (in fact sharp) upper bound on the aggregate contribution margin. Thus, with this calculation in mind, it becomes more appropriate to abandon the γ_i and γ notation and to work now with

$$\eta = \left(\sum_{i=1}^n a_i^s\right)^{\frac{1}{s}} \tag{9}$$

which we shall refer to as the *aggregate market indicator*. In this preferred notation we now have

$$x_i^* = \frac{a_i^s}{\eta^s}\overline{X}. \tag{10}$$

The formula implies that the value of the firm (joint maximum return) is $\eta\overline{X}^\beta$, showing the bound in (8) to be sharp. Note also that η is the maximisation value of $\sum_{i=1}^n a_i x_i^\beta$, subject to $\sum_{i=1}^n x_i = 1$. For analysis in the following section it is also useful to note the form that the Lagrange multiplier associated with the centralised (c) optimisation problem (2) takes. From the first order condition on the Lagrangian we have $\lambda_c = a_i\beta x_i^{\beta-1}$, so substituting in (10) we see that:

$$\lambda_c = \beta\eta\overline{X}^{-\frac{1}{s}}. \tag{11}$$

Evidently the multiplier increases as the stock decreases, that is, the lower the resource stock level the higher the opportunity cost of using up scarce(r) resource.

3.2. *Decentralised Price Disbursion Mechanism*

Here we assume that the divisions are required to pay[2] a price w for any central resource disbursed to them. Unlike in the centralised mechanism, they are free to choose their own proportionate share of $\overline{X}$ and hence we describe this mechanism as decentralised. The centre's problem is now transformed from being one in which n (physical) individual disbursions need to be determined, to one in which a single uniform price needs to be identified that will implement the coordination optimally. Given that in practice there may be many sunk resources, such decentralisation is of potential benefit to the centre. However, it is important to confirm that the optimal price for this problem denoted w^* leads to the divisions (acting alone, in their own respective self-interest) choosing to consume $x^* = (x_1^*, x_2^*, \ldots, x_n^*)$ as in Section 2.1, otherwise there must be an inefficiency loss associated with the decentralised price disbursion mechanism. Before considering overall firm-wide optimisation, let us first consider how the individual divisions respond in a decentralised fashion to the charging of some general w for the use of the resource. Each profit-maximising division will self-select a consumption amount $\hat{x}_i = \arg\max\, a_i x_i^\beta - w x_i$, that is, by the first order condition choose $\hat{x}_i = \left(\frac{a_i \beta}{w}\right)^s$. This reflects how the divisions choose their consumption plans for any w. The problem for the centre then is to choose the optimal w, which, stated formally, is to determine:

$$w^* = \arg\max_{w} \textstyle\sum_{i=1}^n \left[a_i \hat{x}_i^\beta - w \hat{x}_i\right] \qquad (12)$$

$$\text{s.t. } \hat{x}_i = \left(\frac{a_i \beta}{w}\right)^s, \forall i \in \{1, 2, \ldots, n\}, \qquad (13)$$

$$\textstyle\sum_{i=1}^n \hat{x}_i = \overline{X}. \qquad (14)$$

Here the first constraint is the i'th divisional input demand function $\hat{x}_i$, derived directly from each of the n divisional problems:

$$\hat{x}_i = \arg\max_{x_i}\, a_i x_i^\beta - w x_i, \forall i \in \{1, 2, \ldots, n\}, \qquad (15)$$

where $w\hat{x}_i$ can clearly be interpreted as a cost allocated to division i for disbursed resource. Actually, the equivalent problem of maximising the aggregate contribution $\sum_{i=1}^n a_i \hat{x}_i^\beta = w^{-\beta s} \eta^s \beta^{s\beta}$ occurs when w is least subject to $\sum_{i=1}^n \hat{x}_i \leq \overline{X}$, i.e. $\eta^s \beta^s w^{-s} \leq \overline{X}$, and this clearly occurs when:

$$w = w^* = \beta \eta \overline{X}^{-\frac{1}{s}}. \qquad (16)$$

That is, the optimal decentralised price to charge can be determined without first solving the centralised problem. All the centre needs to do is observe[3] the parameters β, η and $\overline{X}$ and then set w^*. It does not need to determine individual divisional disbursions. In the following subsection we now enquire further into the nature of the $w^* \hat{x}$ charges. Note throughout that the centre sets the least possible resource price consistent with the available resource level.

Remark 1. *Form of the Valuation Ratio*

It is interesting to observe that the optimal contribution is $\eta \cdot \overline{X}^\beta$, whereas the value of the resource/stock under the optimal decentralised price is

$$w^* \cdot \overline{X} = \beta \eta \overline{X}^{1-\frac{1}{s}} = \beta \eta \overline{X}^\beta \qquad (17)$$

thus the ratio of resource value to the value of its product/output is β. We shall see this valuation ratio reappearing in more general contexts.

3.3. *The α Cost Recovery Theorem*

As we can see from (16), the decentralised price disbursion mechanism is optimal because the price is set equal to the opportunity cost (Lagrangian/shadow price) of using the scarce (sunk) resource. However, is it valid to conclude that this decentralised mechanism is a form of cost allocation, or is the price purely the result of a mathematical programming exercise, in which the shadow price is critical and the original cost of the sunk resource irrelevant?

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[2] See Amershi and Cheng (1991) for a discussion concerning the equivalence between cost allocation and transfer pricing procedures.

[3] The relaxation of the assumption that a_t is publicly-observed could lead to interesting extensions in a number of directions. From the perspective of the incentives literature, this would be an obvious choice of variable to assume is only privately observed by individual divisional managers, and hence one could explore how cost allocation procedures may be structured to motivate revelation of such private information. Alternatively, one could view a_t as sample information that is collected centrally, and hence issues of experimental design and estimation arise. Another possible extension, which we choose to explore here, arises in dynamic contexts when only the current a_t variable is known and current disbursion procedures need to incorporate expectations over the evolution of an $a_{t+1}, a_{t+2}, \ldots$ process so as not to act myopically. Thus our concern will be with issues such as, given a fixed stock at some intermediate time and currently 'reasonably good' conditions, how much more than the average stock level should be disbursed given that there is a positive probability that conditions could be 'even better' or alternatively 'much worse' in following periods? This rather imprecise statement of the problem will be made precise by reference to explicit formulation of the dynamic optimisation problem.

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In order to address this issue we turn to consideration of how the resource level $\overline{X}$ was originally determined, assuming that the cost of acquiring the subsequently fixed level of the resource $C(\overline{X})$ satisfies:

$$C(\overline{X}) = \overline{X}^{\alpha} \tag{18}$$

with $\alpha > \beta$. Assuming the centre knows $a=(a_1, a_2,..., a_n)$, the centre determines $\overline{X}$ as follows:

$$\overline{X} = \underset{X,x}{\arg\max} \textstyle\sum_{i=1}^{n} a_i x_i^{\beta} - C(X) \tag{19}$$

$$\text{s.t.} \textstyle\sum_{i=1}^{n} x_i = X,$$

$$x_i \geq 0.$$

Evidently this is equivalent to maximising $\eta X^{\beta} - X^{\alpha}$, since η is the maximum value of $\sum_{i=1}^{n} a_i x_i^{\beta}$ subject to $\sum_{i=1}^{n} x_i = 1$, and so the first order conditions give $\dfrac{\beta\eta}{\alpha} = X^{\alpha-\beta}$ and this is a global maximum if and only if $\alpha > \beta$ (if $\alpha=\beta$ the maximum is ∞ and if $\alpha < \beta$ we obtain a minimum). Thus:

$$\overline{X} = \left(\frac{\alpha}{\beta}\right)^{\frac{1}{\beta-\alpha}} \eta^{\frac{1}{\beta-\alpha}}. \tag{20}$$

From (16), (10) and (20) we have:

$$\textstyle\sum_{i=1}^{n} w^{*}\hat{x}_i = \sum_{i=1}^{n} \beta\eta \overline{X}^{-\frac{1}{s}} \dfrac{a_i^s}{\eta^s} \overline{X}$$

$$= \overline{X}^{1-\frac{1}{s}} \beta\eta$$

$$= \overline{X}^{\beta} \beta\eta$$

$$= \alpha C(\overline{X}). \tag{21}$$

This result means that if we have constant returns to scale ($\alpha=1$), then the optimal price (w^{*}) based disbursion mechanism allocates full cost. However, if for instance $\alpha < 1$, then full cost allocation can never be optimal since we require:

$$w^{*}\,\overline{X} = \textstyle\sum_{i=1}^{n} w^{*}\hat{x}_i < C(\overline{X}), \text{ if } \alpha < 1. \tag{22}$$

When the centre determines $\overline{X}$, with $\alpha < 1$, the inclusion of one division's plans to consume the resource reduces[4] the overall unit purchase cost for the resource. Thus, in order to ensure the decentralised (divisional) decision regimes incorporate this global externality effect, less than the full cost of the resource is allocated via $\sum_{i=1}^{n} w^{*}\hat{x}_i$. Does this mean that when $\alpha \neq 1$ we cannot define an optimal price disbursion mechanism that is equivalent to allocation of the cost of the sunk resource? It is clear from (21) that there exists a simple operational rule for relating the optimal opportunity cost charge to the incurred sunk costs. That is, observing divisions being charged α times the sunk cost is consistent with the decentralised optimal behaviour. Thus, under the above conditions, the observation of sunk costs being allocated is consistent with economically optimal resource consumption decisions. (We will generalise this statement in terms of expcted behaviour when we introduce stochastic parameters in Section 5.) A critical question at this stage is: do these results follow only because of the simple assumptions we have made concerning omniscient observation (of a_i) in the static operating environment? That is, are these results generalisable to a wider class of decision problems? Thus, in the following sections we consider deterministic and stochastic dynamic models in turn to address this fundamental generalisability question. In fact, we show that the results survive generalisation. However, before reconsidering the $a(t)$ process, we introduce some additional notation to simplify our later exposition.

3.4 A General Reduction to the Case of One Division

In the following analysis, we shall establish that the i x t disbursal problem can be reduced to an equivalent t disbursal problem for a *representative* division. A division only needs to know 'its' own vector of market conditions and the period unit cost allocation prices as set out below (we relax this divisional omniscience assumption in later sections). As we shall see, this result follows in part from the commonality of the divisional production coefficient β. Let x_t denote the amount of the sunk resource $\overline{X}$ disbursed among *all* the divisions in period t, and moreover let $x_{i,t}$ represent the amount disbursed to division i in period t (this could be instantaneous or per unit time). As we shall see via Observation 2, without loss of generality we can simplify the presentation and assume $\beta = \frac{1}{2}$ so that $s=2$. Thus, if for the moment we restrict attention to the centre's period t problem, the equivalent formulation here to that of Section 3 is:

$$x_t^{*} = \underset{x_t}{\arg\max} \textstyle\sum_{i=1}^{n} a_{i,t}\sqrt{x_{i,t}} \tag{23}$$

$$s.t. \textstyle\sum_{i=1}^{n} x_{i,t} = x_t.$$

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[4] If we had $\alpha > 1$, then the centre would not need to coordinate purchasing of the resource, since aggregate costs would be lower if each division purchased its own requirement in the marketplace. Our concerns are with the more interesting problem of $\alpha < 1$, since under this assumption, central (aggregate) purchase lowers total cost but then disbursement coordination becomes an issue.

Thus we have:

$$x_{i,t}^* = \left(\frac{a_{i,t}}{\eta_t}\right)^2 x_t \tag{24}$$

with:

$$\lambda_{c,t} = \frac{1}{2}\eta_t \overline{X}_t^{-\frac{1}{2}},$$

where $\eta_t = \sqrt{\sum_{i=1}^{n} a_{i,t}^2}$. Substitution in (23) yields the period t contribution as $\eta_t\sqrt{x_t}$, hence the centre's objective function is:

$$x_t^* = \arg\max_{x_t} \sum_T \eta_t \sqrt{x_t} \tag{25}$$

or:

$$x_t^* = \arg\max_{x_t} \int_0^T \eta_t \sqrt{x_t} dt \tag{26}$$

depending on whether we wish to consider a discrete or continuous time problem, subject to $\sum_t x_t = \overline{X}$ or $\int_0^T x_t dt = \overline{X}$ respectively. Thus, we interpret x_t^* as the optimal stock disbursal in period/instant t and η_t as the *aggregate market indicator.*[5] The introduction of this new notation considerably simplifies our presentation, since it subsumes i dependencies. It is straightforward to show that no such simplification arises if the technology index β were to vary over divisions. Note that in order to facilitate simplicity of presentation we have ignored discounting issues; this is reconsidered as appropriate (see Sections 3 and 5). As before (see (16)) it is straightforward to show that the optimal dynamic disbursal mechanism can be decentralised by setting:

$$w_t^* = \frac{1}{2}\eta_t \frac{1}{\sqrt{x_t}} = \lambda_{c,t} \tag{27}$$

and thus sunk cost allocation of the form $w_t^* x_{i,t}^*$ will guide divisional managers to take (decentralised) optimal sunk cost resource consumption decisions. In terms of the generalisability of this model we note that:

Observation 1. The centre's objective function (25) can always be rewritten as a decentralised program determining cost allocation rules w_t^*, by using (25) and (27) and choosing:

$$w_t^* = \arg\max_{w_t} \sum_T \frac{\eta_t^2}{2w_t}, \tag{28}$$

$$s.t. \sum_T \frac{\eta_t^2}{4w_t^2} = \overline{X}.$$

Observation 2. The above results hold for a general concave Cobb-Douglas production function x^β, $0 < \beta < 1$; the calculations simply require that the aggregate market indicator is:

$$\eta_t = \left(\sum_i a_{i,t}^s\right)^{\frac{1}{s}}, \tag{29}$$

where s is the dual variable to $\beta = \frac{1}{r}$ connected as before by the equation:

$$\frac{1}{r} + \frac{1}{s} = 1. \tag{30}$$

Observation 3. Formulae (25) and (27) allow the argument of Section 3 (α cost recovery theorem) to apply to the discrete multi-period context, yielding

$$\sum_T w_t^* \hat{x}_t = \alpha \overline{X}^\alpha \tag{31}$$

where $\overline{X}$ now maximises over X, x_t the sum (19) over time in place of i, so long as $\eta^s = \sum_t \eta_t^s$. This result continues to hold for continuous time $\int_0^T w_t^* \hat{x}_t dt = \alpha \overline{X}^\alpha$ (we prove that the α cost recovery theorem also holds in the stochastic case in Appendix B, with deterministic recovery being replaced by expected recovery).

3.5 Relating our Micro-economic Production Model to the Queuing Theoretic-based Formulations

In the following sections we shall explicitly introduce stochastic variation of parameters within a dynamic setting. However, before doing so, it is interesting to relate how our formulation of the constrained resource (opportunity costing) problem relates in general to the queuing-based formulations discussed in the previous section. First, it is important to note that our restriction to concave technologies excludes production functions that embody learning by doing. However, it should be recognised that we introduce this restriction because otherwise non-existence of (interior) optimal solutions may arise. Also, as mentioned briefly in the introduction, our production setting is different from the service-queuing framework. For instance, in Balachandran's and Schaefer's (1979) model, only one division could be served, while in ours, all divisions may be served/disbursed resource. This difference arises because some organisational resources such as a computer service department may be best modelled within a queuing framework where the use of the service (e.g. central computer time) precludes others from using the resource until the division/product in question has completed its consumption. However, there exists another class of resources for which consumption by one division may reduce, but does not stop, synchronous consumption by another division.

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[5] Given the way we have defined the aggregate market indicator, it could equally apply to uncertainty over production conditions, since $\eta_t = \sqrt{\sum_{i=1}^{n} a_{i,t}^2} = \sqrt{\sum_{i=1}^{n} (c_{i,t}\theta_{i,t})^2}$.

An example of such a resource is the advance purchase of a raw material that will not be purchased again for some time. That is, our model formulation and the queuing approach are best viewed as complementary formulations. The question of which is most appropriate in a given setting thus depends on the synchronicity of possible consumption of the resource in question. This difference explains why in the model of Balachandran and Srinidhi (1988) the congestion cost charged exceeds the cost of running a common facility. That is, in their queuing model, once a service department decides to work for a particular user, this imposes a very high opportunity cost on the other users since they cannot have service until the job is finished. In contrast, in our model, setting the possibility of synchronous consumption means that the opportunity cost is not so high. Given a lower opportunity cost, it is important to recognise that some charge must still be made, since eventually no resource will be available, or alternatively less deserving divisions will consume the resource.

Another interesting variation in the models is that in the Balachandran and Srinidhi (1990) model, full-cost application is optimal if average (planned) unit delay costs and average contribution margins are realised, whereas in our model the α recovery theorem implies that only α (< 1) of the capacity cost is recovered. This arises because with the Cobb Douglas type cost function, the ratio of marginal cost (opportunity cost) to average cost (charged with cost allocation) is given by the exponent α. That is, the average cost-charging cost allocation rule must be multiplied by the exponent if it is to give the marginal cost.

4. Deterministic continuous time disbursion model

In order to facilitate a dynamic specification for the problem, we need to make an explicit assumption about evolution of the $a(t)$, $t \in [0, T]$ process ($T < \infty$). In this section we shall assume that the evolution of the $a(t)$ process is known in advance and is constant through time ($a(t)=a$). For this section our main focus is on understanding how the dynamics affect the centre's decision-making problem. In following sections we will consider the implications of relaxing the $a(t)$ omniscience and time invariance assumptions. In particular, in this dynamic formulation we shall be concerned with how to determine the optimal time path for the disbursion price denoted $w(t)$, and to see how this is related to the static disbursion price w derived in the previous section.

For the dynamic formulation during time $t \in [0, T]$, the state variable at time t is $X(t)$, the amount of resource remaining at time t. We start with $\overline{X}$ units of the scarce corporate resource and by time T we have disbursed it all, hence we require $0 \leq X(T) \leq X(t) \leq X(0) = \overline{X}$. The control variable is the instantaneous disbursement vector $x(t)$. Hence if δ denotes the instantaneous rate of discount, the optimal control vector $x^*(t)$ is chosen such that:

$$x^*(t) = \max_{x(t)} \int_0^T e^{-\delta t} a x^{\beta}(t) dt \qquad (32)$$

$$\text{s.t.} -x(t) = \frac{dX}{dt}.$$

Forming the current value Hamiltonian H for the problem and letting $\mu(t) = e^{\delta t}\lambda(t)$, we see that the necessary conditions are:

$$-\frac{\partial H}{\partial X} \equiv 0 = \dot{\mu} - \delta\mu(t), \qquad (33)$$

$$\frac{\partial H}{\partial x} \equiv a\beta x(t)^{\beta-1} - \mu(t) = 0, \qquad (34)$$

$$\dot{X} = \frac{-\partial H}{\partial \mu} \equiv -x(t). \qquad (35)$$

From (33), $\lambda(t) = \lambda$, a constant. From (34):

$$x^*(t) = \left(\frac{\lambda}{a\beta}\right)^{-s} e^{-\delta s t} \qquad (36)$$

and from (35) and (36) we have:

$$\frac{dX}{dt} = k e^{gt},$$

where $k = -\left(\frac{\lambda}{\alpha\beta}\right)^{-s}$; g $= -\delta s$, which implies that:

$$X(t) = \frac{k}{g} e^{gt} + C.$$

Using the boundary conditions we see that:

$$X(t) = \frac{\overline{X}}{(1 - e^{gT})}(e^{gt} - e^{gT})$$

which sets the value of λ via

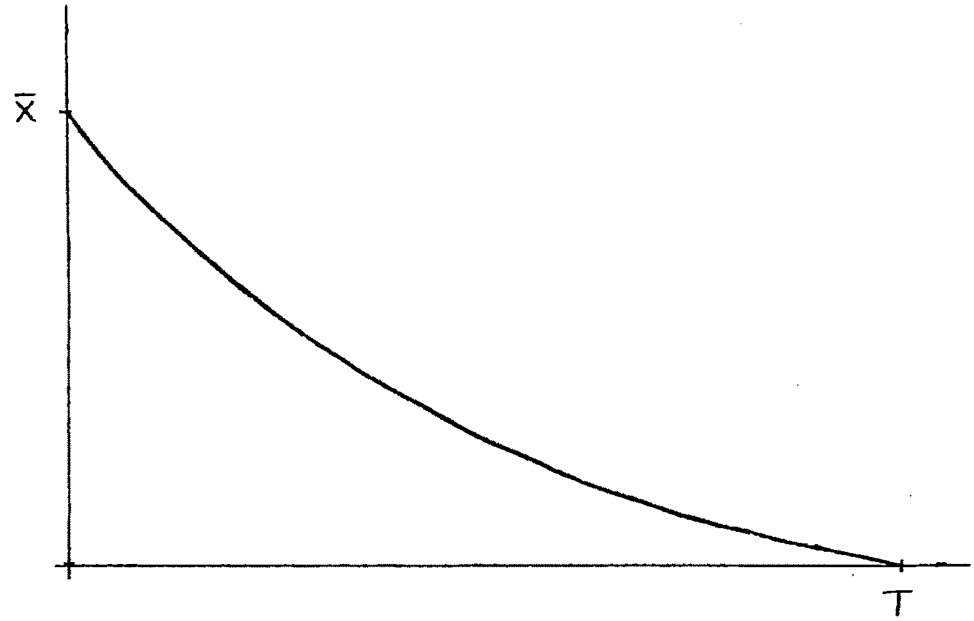
$$-k = \left(\frac{a\beta}{\lambda}\right)^{s} = \frac{\delta s \overline{X}}{(1 - e^{gT})}.$$

Thus

$$\lambda = a\beta\, (\delta s)^{-\frac{1}{s}} \overline{X}^{-\frac{1}{s}} (1 - e^{gT})^{\frac{1}{s}}$$

or $\lambda = \beta\eta\overline{X}^{-\frac{1}{s}}$ as usual, since λ corresponds to the

Figure 1
Graph of x (t)



stock constraint, and $\eta^S = \int_0^T (e^{-\delta t}a)^s \, dt = a^s \left[\frac{e^{-s\delta t}}{-s\delta}\right]_0^T = \frac{a^s}{s\delta}(1 - e^{-s\delta t})$.

As Figure 1 clearly illustrates, in the dynamic problem with continuous time discounting, it is optimal to disburse more of the scarce resource early on. It is straightforward to prove that the centre can determine a decentralised price-based mechanism which implements the optimal continuous time disbursal program. Again the price is related to the shadow price (opportunity cost) in a simple fashion. For the continuous time formulation, the price function $w^*(t)$ is set equal to the current value shadow price $e^{-\delta t}\lambda$. We do not present the derivation of the details here, as we present a generalised form of the result in the next section.

Given our ability to generalise our static results to a continuous time disbursal control problem, we shall now consider whether we can establish the results for cases where the $a(t)$ are either independent and identically distributed realisations for discrete time, or alternatively, evolve according to a Wiener stochastic process.

5. A simple stochastic discrete time disbursion model

In the last section we made an omniscience assumption concerning decision-makers' knowledge of the time path for $a(t)$. In these next two sections we relax this assumption. In the current section we are mainly concerned with discrete time, and we make the simplest assumption that as time is discrete the random variables $a(t)$ and $a(t+1)$, for each integer $t \in [0, M-1]$, are independently and identically distributed.[6]

Let us consider a discrete M period model, in which the period market indicator a_t takes values dependent on one of two possible states of nature labelled $\zeta \in \{a, A\}$ where $a < A$. For illustrative purposes we may want to take $a=1$, $A=2$. We shall assume that at any time t we know the current state ζ_t of the market. We model how expectations for the M further days ahead are formed as follows. We shall assume that the probability of the ζ occurring at any future date t is p_ζ. Furthermore, for simplicity, we assume $a_t = \zeta_t$ where ζ_t is the state at time t. This is the simplest model, though $a_t = H(t, \zeta_t)$ could easily be accommodated.

5.1. Dynamical Programming Argument

Suppose at time t there are N future production periods left at times labelled $t, t+1, \ldots t+N-1$, and that there is an amount $\bar{X}$ of resource available for these N periods. We are interested in maximising the quantity

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[6] See, for instance, Dixit and Pindyck (1994) for an introductory discussion of this type of model.

$$E_t[\sum_{s=t}^{t+N-1} a_s\sqrt{x_s}]$$

subject to

$$\sum_{s=t}^{t+N-1} x_s=\overline{X}.$$

Let us put $x_s=\overline{X}\cdot z_s$ so that

$$\sum_{s=t}^{t+N-1} z_s=1$$

and we now wish to maximise the following expression over all such $\{z_s\}$

$$A_N(\{z_s\})=E_t[\sum_{s=t}^{t+N-1} a_s\sqrt{z_s}].$$

Note that by our assumptions this is in fact not dependent on t. Let the supremum of all such expressions (which is finite by Hölder's inequality) be A_N.

We obtain a recurrence relation satisfied by A_N, by examining the definition of A_N+1. Suppose therefore that at some time t there are $N+1$ future production periods left. We are now interested in maximising over all $\{x_s : s=t,t+1,\ldots,t+N\}$ subject to $\Sigma x_s=1$ the quantity

$$E_t[\sum_{s=t+0}^{t+N} a_s\sqrt{x_s}].$$

We shall do so by separating out the decision variable x_t from those of the remaining N periods. The maximisation will be conducted by appealing to two ideas: the standard dynamical programming idea that time is divided into two periods (time t (now) and the remaining future $t+1$, $t+2,\ldots$) and secondly a transformation using a separation of variables under the expectations operator as follows

$$E_t[\sum_{s=t+0}^{t+N} a_s\sqrt{x_s}]=E_t[a_t\sqrt{x_t}+\sum_{s=t+1}^{t+N} a_s\sqrt{x_s}]$$
$$=E_t[a_t\sqrt{x_t}+E_{t+1}[\sum_{s=t+1}^{t+1+N-1} a_s\sqrt{x_s}]]$$

or, writing $x_s=(1-x_t)v_s$ for $s=t+1,\ldots$ so that since

$$\sum_{s=t+1}^{t+N} x_s=1-x_t$$

we may continue the calculation in terms of A_N $(\{v_s\})$. Thus we have

$$E_t[\sum_{s=t+0}^{t+N} a_s\sqrt{x_s}]$$
$$=E_t\left[a_t\sqrt{x_t}+\sqrt{1-x_t}E_{t+1}[\sum_{s=t+1}^{t+1+N-1} a_s\sqrt{v_s}]\right]$$
$$=E_t\left[a_t\sqrt{x_t}+\sqrt{1-x_t}E_u[\sum_{s=u}^{u+N-1} a_s\sqrt{v_s}]\right]$$
$$=E_t[a_t\sqrt{x_t}]+E_u[\sum_{s=u}^{u+N-1} a_s\sqrt{v_s}]\cdot E_t\left[\sqrt{1-x_t}\right]$$

where we have substituted u for $t+1$ above. Note now that the expression

$$E_u[\sum_{s=u}^{u+N-1} a_s\sqrt{v_s}].$$

is independent of u. Once the realisation a_t is known, we observe that since $\Sigma v_s=1$, we wish to maximise

$$a_t\cdot\sqrt{x_t}+\sqrt{1-x_t}A_N(\{v_s\})$$

and this is maximised for any choice of x_t when $\{v_s\}$ is selected to maximise $A_N(.)$. We are thus left to maximise

$$a_t\cdot\sqrt{x_t}+\sqrt{1-x_t}A_N$$

for which the maximising value is

$$x_t=\frac{a_t^2}{\alpha^2+A_N^2}$$

and the maximum value is evidently

$$\sqrt{a_t^2+A_N^2}$$

hence

$$A_{N+1}=E_t\left[\sqrt{a_t^2+A_N^2}\right]=p_a\cdot\sqrt{a^2+A_N^2}+p_A\cdot\sqrt{a^2+A_N^2},$$
$$A_0=0.$$

It is clear that $A_{N+1}\geq A_N$ and that if $A\geq a$ we have $A_{N+1}\geq\sqrt{a^2+A_N^2}$ so $A_N\geq\sqrt{N}\cdot a\rightarrow\infty$ yielding $A_{N+1}/A_N\rightarrow 1$. Guided by this we put

$$b_N=\frac{A_N}{\sqrt{N}}.$$

It may then be proved (cf. Appendix A) that

$$\lim_{N\rightarrow\infty} b_N=b\equiv\sqrt{E_t[a_t^2]}=\sqrt{(p_a\cdot a^2+p_A\cdot A^2)}.$$

5.2. Optimal Disbursion Policy

As a result, if we are solving the problem of subdividing a resource $\overline{X}$ across $N + 1$ future periods with a current known market coefficient a_0, we must maximise over x_0

$$a_0\cdot\sqrt{x_0}+\sqrt{\overline{X}-x_0}A_N=a_0\cdot\sqrt{x_0}+\sqrt{\overline{X}-x_0}b_N\sqrt{N}.$$

The optimal choice currently is

$$x_0=\frac{a_0^2}{a_0^2+Nb_N^2}\cdot\overline{X}.$$

Thus the optimal disbursion policy when the current state is ζ is

$$x_0=\frac{\zeta^2}{\zeta^2+Nb_N^2}\cdot\overline{X}$$

$$=\frac{\zeta^2}{\zeta^2/N+b_N^2}\cdot\frac{\overline{X}}{N},$$

which for large N is approximately

$$\frac{\zeta^2 d}{E_p[\zeta^2]},$$

where $d=\frac{\overline{X}}{N}$ is the average period allocation.

Remark 2. *We note that for fixed d the assumption of a contribution function for the following N periods in the form $b_N N\sqrt{d}$ with b_N convergent to b say, implies that the optimal disbursal policy*

$$\frac{\zeta^2 d}{\zeta^2/N+b_N^2}=\frac{\zeta^2 d}{b_N^2(1+\zeta^2/Nb_N^2)}$$

for any $\varepsilon > 0$ is not greater than

$$\frac{\zeta^2 d}{b^2}(1+\varepsilon)$$

when N is large enough, that is, the policy is asymptotically dependent on the state and not also on the time left, as to be expected intuitively.

The above asymptotic formula for the optimal allocation is of interest, since similar formulae are obtained by over and under-estimation techniques of the stochastic problem using deterministic methods based on a 'prescience' argument to be developed below.

5.3. Alternative Derivation of A_n

A more intuitive derivation of the above technical result can be developed using probabilistic arguments, as follows. The allocation problem can be thought of in terms of the expected number of outcomes of a and A, being the actual number of respective realisations. Since for large N we would expect to see Np_a number of outcomes a, and Np_A number of outcomes A, let us formulate the allocation problem as

$$\max \quad Np_a a\sqrt{x_a}+Np_A A\sqrt{x_A}$$

subject to

$$Np_a x_a+Np_A x_A=Nd,$$

where $d=X/N$ is the average allocation per period of the stock X. Equivalently, we maximise

$$p_a a\sqrt{x_a}+p_A A\sqrt{x_A}$$

subject to

$$P_a x_a+P_A x_A=d.$$

We call this a *reduction argument*, since we apparently reduce the number of production periods from N to 2. Thus the indirect contribution becomes instead of $A_N\cdot\sqrt{X}=b_N\sqrt{N}\sqrt{X}$:

$$\omega\cdot\sqrt{N}\sqrt{X},$$

where $\omega=\sqrt{p_a a^2+p_A A^2}$.

Comparing with the earlier derivation of the optimal disbursion policy, we conclude that for large enough N we have

$$\frac{A_N^2}{N}=b_N^2\approx p_a a^2+p_A A^2.$$

The disadvantage of the above argument is that we have not quantified the error committed in assuming the expected number of outcomes as the actual number of outcomes. A more carefully reasoned argument may be constructed by appealing to over-estimates of the low state frequency (correct with probability $1 - \varepsilon$) given by the central limit theorem. The details are straightforward and so are omitted. However, this provides an under-estimate of the expected contribution which does agree with an over-estimate asymptotically. Thus the under-estimate is not far off the limiting value. It is important therefore to note that the allocations used in both these estimates are asymptotically optimal for the original control problem.

The above under-estimation procedure requires a complementary one to obtain an over-estimate of the expected contribution, which we shall now derive.

5.4. Prescience Argument as an Overestimation Technique

For M large enough one might argue that when there are M production periods ahead, our optimal disbursion policy will depend significantly only on the current state of the market, i.e., it takes the form x_ζ independently of M when the market state is ζ. Moreover, relative to the total number of periods, the few periods nearer to the terminal time, which might diverge from the large-scale behaviour, will contribute relatively insignificantly to the total contribution.

As a first step we therefore examine what the optimal disbursion should be when it is known ahead of time that the frequency of the high state $\zeta = A$ will be $f = k/M$ where M is the number of periods left. The optimal response with foreknowledge of f is bound to be better than a dynamical programming strategy. Let R_f denote the contribution given foreknowledge of f.

Returning to our original disbursion problem, our next step is to make the weaker assumption that immediately after the decision to select the current disbursal has been taken, we shall have knowledge of the frequency f just as in the previous step. With this assumption we have somewhat better information prior to selecting the current disbursal than in the original problem. We then compute the expected contribution given our additional assumption, viz:

$$\hat{R} = \sum_f \Pr[f] \cdot R_f$$

which must therefore be greater than or equal to the maximum expected contribution $R(y_0)$.

This then is our over-estimate for the maximum expected contribution function. Thus the essential features of what we call the *prescience argument* are that:

- The asymptotic form of the prescient contribution agrees with the under-estimate obtained by the reduction method.
- The prescience argument can be easier to implement on computer, since it calls on the binomial coefficients rather than run iterations.

Having provided the alternative route to an asymptotic formula for A_N we begin to calculate the prescient estimate.

The future realisation $a = (a_1, \ldots a_M)$ gives rise to a frequency of high state ($\zeta = A$) realisations $f = f((a_1, \ldots a_M))$. The probability $p_M(f)$ of frequency f occurring is:

$$p_M(f) = \binom{M}{k} p_1^{M-k} p_2^k, \qquad (37)$$

when $f = \dfrac{k}{M}$. It is easy to calculate that the maximum aggregate contribution obtainable from the expression

$$fA\sqrt{x_A} + (1-f)a\sqrt{x_a}$$

subject to the resource constraint

$$Mfx_A + M(1-f)x_a = \overline{X}$$

is

$$\sqrt{M\overline{X}E_f[\zeta^2]},$$

where E_f denotes[7] expectation of the function of state ζ, assuming that the probability of the high state ($\zeta = A$) is f, i.e.

$$E_f[\zeta^2] = fA^2 + (1-f)a^2.$$

Thus the *expected aggregate contribution*, *EC*, given a disbursion x for the current period ($t = 0$), is:

$$EC = a_0\sqrt{x} + \sum_{0 \le f \le 1} p_M(f) \sqrt{M(\overline{X} - x)E_f[\zeta^2]} \qquad (38)$$

Thus if we let:

$$r(M) = \sum_{0 \le f \le 1} p_M(f) \sqrt{E_f[\zeta^2]}, \qquad (39)$$

$$EC = a_0\sqrt{x} + \sqrt{M(\overline{X} - x)}\, r(M). \qquad (40)$$

As we shall see below $r(M)$ can readily be calculated, since:

$$\lim_{M \to \infty} r(M) = \sqrt{E_p[\zeta^2]} \qquad (41)$$

where the expectation E_p is now calculated relative to the probabilities p_ζ of the states. This result follows from the law of large numbers, but we give in Appendix C a more elementary proof (the argument could be extended to the case of more than two states).

In our simplified two-state case $a = 1$, $A = 2$, the limiting value is:

$$r(M) \to \sqrt{p_1 + p_2 2^2} = \sqrt{1 + 3p_2} \qquad (42)$$

and a computer-assisted calculation shows that the discrepancy between $r(M)$ and its limit is typically less than 1% when $M \ge 10$.

The first order condition for expected aggregate contribution maximisation is:

$$\frac{\partial EC}{\partial x} \equiv \frac{1}{2} a_0 \sqrt{\frac{1}{x}} - \frac{r(M)\sqrt{M}}{2\sqrt{\overline{X} - x}} = 0 \qquad (43)$$

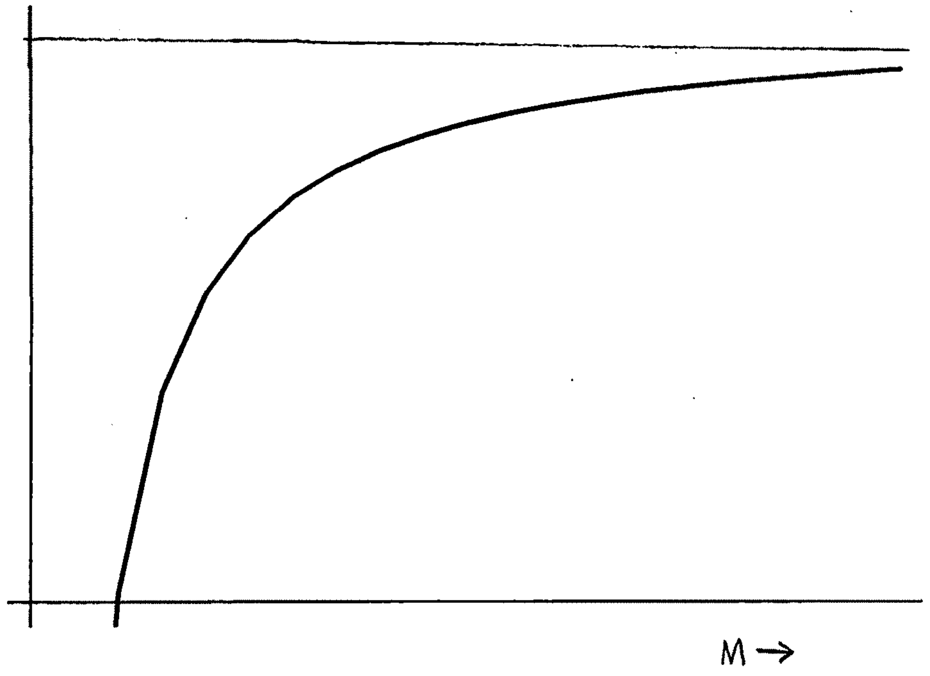
which yields:

$$x = \frac{a_0^2 \overline{X}}{a_0^2 + r(M)^2 M} \qquad (44)$$

---

[7] The optimal contribution for the problem of max $M\sum_{s=1}^{2} s \cdot f_s \cdot \sqrt{x_s}$ subject to $M\sum_{s=1}^{2} f_s \cdot \sqrt{x_s} = Y$ is $\sqrt{M \cdot Y \cdot E_f[s^2]}$. Here f_s denotes the frequency of state s and $f = f_2$ (the high state). This may be verified by a standard Lagrangian argument.

Figure 2
Graph of r (M)



The optimal disbursion policy when the current state is ζ follows a similar formula to that derived earlier:

$$x(\zeta) = \frac{\zeta^2}{r(M)^2 + \frac{\zeta^2}{M}} \cdot \frac{\overline{X}}{M} \tag{45}$$

For large M this is approximately:

$$x(\zeta) = \frac{\zeta^2 d}{E_p[\zeta^2]} \tag{46}$$

where $d = \frac{\overline{X}}{M}$ is the average period disbursion. Computed dynamic programming solutions (not tabled here) are in close agreement with (45) even for small M, which is presumably of some practical significance.

6. Wiener process disbursal models

The simplest deterministic formula connecting the increment in a state variable such as η_t to the time increment dt is one of direct proportion, viz:

$$d\eta_t = f(\eta_t)dt,$$

and this can be amended for application in stochastic contexts by the inclusion of an extra random term to give

$$d\eta_t = f(\eta_t)dt + \sigma(\eta_t)dz \tag{47}$$

where dz represents a standard Wiener process. We shall now provide readers unfamiliar with this formulation with a brief review of the stochastic calculus that we need for our analysis. Speaking crudely, we are concerned with increments Δx in a variable x_t, where $\Delta x = a\Delta t + b\Delta z$, in which the time increment and the coefficients a, b are deterministic and the stochastic increment Δz behaves so that when we apply the expectations operator $E = E_t$ (i.e., expectation given information available at time t), we may proceed intuitively and make the substitutions $E[\Delta z] = 0$ (except when x_t is at a boundary value) and $E[(\Delta z)^2] = \Delta t$. Thus if we substitute for Δx in the Taylor expansion:

$$F(x + \Delta x) = F(x) + F'(x)\Delta x + \frac{1}{2}F''(x)(\Delta x)^2 + o((\Delta x)^3)$$

(valid provided enough smoothness is assumed) we get

$$F(x+\Delta x)=F(x)+F'(x)\{a\Delta t+b\Delta z\}+\frac{1}{2}F''(x)\{a\Delta t+b\Delta z\}^2+o((\Delta x)^3)$$

$$=F(x)+aF'(x)\Delta t+\frac{1}{2}b^2\ (\Delta z)^2F''(x)+b\Delta zF'(x)+ab\Delta t\Delta zF''(x)+\frac{1}{2}a^2F''(x)\ (\Delta t)^2+o((\Delta x)^3).$$

Applying the expectations operator and the substitutions mentioned above, we obtain the Itô expansion:

$$E[F(x+\Delta x)]=F(x)+\Delta t\{aF'(x)+\frac{1}{2}b^2F''(x)\}+o((\Delta t)^2),$$

from which we customarily drop the error term. In what follows below we tacitly assume all the necessary smoothness.

6.1. Finite Horizon Problem

We now apply dynamic programming to deal with the choice of control variable over the finite time interval [0, 1] where without loss of generality we have set $T=1$. We prefer here not to use time discounting. Let $S(X,\eta,t)$ denote the maximum expected contribution obtainable through the use of a disbursal function x_τ for $t\leq\tau\leq 1$, given that the market indicator state at time t is $\eta_t=\eta$ and the stock remaining $X_t=X$, assuming a maximum exists. We are now able to argue from the optimality principle that for any $h>0$:

$$S(X,\eta,t)=\max_{\xi}E_{t,\eta}\left[\int_t^{t+h}\eta_\tau\sqrt{\xi_\tau}d\tau+S(X-\int_t^{t+h}\xi_\tau d\tau,\ \eta_{t+h},\ t+h)\right]\qquad(48)$$

where ξ_τ is a disbursal function defined $t\leq\tau\leq t+h$. However, the expression being maximised is equal to:

$$E_{t,\eta}\left[\int_t^{t+h}\eta_\tau\sqrt{\xi_\tau}d\tau\right]+E_{t,\eta}E_{t+h,\eta(t+h)}\left[S(X-\int_t^{t+h}\xi_\tau d\tau,\ \eta_{t+h},\ t+h)\right]\qquad(49)$$

and we now invoke Itô's rule, suitably amended to include all three arguments to obtain:

$$E_{t+h,\eta(t+h)}\ [S(X+dX,\eta+d\eta,t+dt)]=S(X,\eta,t)+\left(-x\frac{\partial S}{\partial X}+\frac{\partial S}{\partial t}+f(\eta)\frac{\partial S}{\partial \eta}+\frac{1}{2}\sigma^2(\eta)\frac{\partial^2 S}{\partial \eta^2}\right)dt\qquad(50)$$

since $dX=-\ xdt$. We are thus led to the Bellman equation:

$$0=\max\left\{\eta_t\sqrt{\xi_t}-\xi_t\frac{\partial S}{\partial X}+\frac{\partial S}{\partial t}+f(\eta_t)\frac{\partial S}{\partial \eta}+\frac{1}{2}\sigma^2(\eta_t)\frac{\partial^2 S}{\partial \eta^2}\right\}.\qquad(51)$$

This patently assumes that $S(X,\eta,t)$ is not only continuous, but also appropriately differentiable. It is not difficult to see from (26) that $S(X,\eta,t)=\sqrt{XV}\ (1,\eta,t)$, i.e., the problem may be rescaled to a unit resource constraint, whereupon the scaling factor comes through the objective function in square rooted form, since the objective function is homogeneous of degree $\frac{1}{2}$ in the resource. Thus, without loss of generality, we write $S(X,\eta,t)=\sqrt{XV}\ (\eta,t)$. Utilising this we now obtain the first order condition, with x for ξ_t:

$$\frac{1}{2}\eta_t\sqrt{\frac{1}{x_t}}=\frac{V}{2\sqrt{X}}.\qquad(52)$$

We thus obtain that the optimal disbursal policy takes the form:

$$x_t=\frac{\eta_t^2X_t}{V^2(\eta_t,\ t)}\equiv g_tX_t,\qquad(53)$$

where X_t is the stock remaining at time t. We note that the optimal policy is separable in g_t and X_t, and that g_t would be expected to be increasing in η_t so that, the more is disbursed, the better the market conditions in the period.

Remark 3. *The optimal policy of (53) can be substituted into the Bellman equation, yielding the following partial differential equation satisfied by* V:

$$0=\frac{\eta_t^2}{2V}+\frac{\partial V}{\partial t}+f(\eta_t)\frac{\partial V}{\partial \eta}+\frac{1}{2}\sigma^2(\eta_t)\frac{\partial^2 V}{\partial \eta_t^2}\qquad(54)$$

We note that according to (27), the internal price is

$$w_t=\frac{1}{2}\eta_t\frac{1}{\sqrt{x_t}}=\frac{V(\eta_t,\ t)}{2\sqrt{X_t}}$$

Remark 4. *Form of the Stochastic Valuation Formula*

The value of the stock remaining is $w_t \cdot X_t = \sqrt{X_t} \cdot V(\eta_t,t)/2 = S(X, \eta_t,t)/2$. More generally, $w_t \cdot X_t = \beta S(X, \eta_t, t)$, so that, as in the deterministic case, the ratio of the value of the stock/input to the value of its product/output is β.

We do not attempt to solve the non-standard partial differential equation (54), since it appears that numerical procedures are called for that take us outside the intended scope of this paper. We content ourselves with solving an ordinary differential equation arising in the infinite horizon problem and regard the solution of (54) as a possible topic for future research.

6.2. *The Infinite Horizon Problem*

If we have a long-term analysis in mind, an infinite horizon formulation may be used. A satisfying feature of this approach is that the problem is more tractable, so that the economic intuition for the solution is more transparent and one may argue that the comparative statics analysis is more straightforward. On continuity grounds, when the solution to the infinite horizon problem is truncated to a large finite interval, it will be in some sense qualitatively near to the solution of the finite horizon problem. Indeed, we shall find that the optimal disbursal is again separable in the stock just as in (53), and so if a small amount of stock remains unused through truncation of the time horizon, this should not cause much distortion to the indirect contribution function on account of stock alone. However, stochastic factors might at first be thought to influence the value of the contribution through the need for the truncation time to be set large enough for stochastic events to 'even out'. We shall nevertheless see that the indirect contribution yield from time t onwards is $e^{-\delta t}\sqrt{X_t}\tilde{V}(\eta_t)$ where X_t is the stock left at time t and $\tilde{V}(\eta_t)$ is a function of only the state η, thus for a bounded process η_t, the truncation time required to achieve accuracy ε in the contribution varies linearly with $\log(\varepsilon)/\delta$, that is, long times on account of stochastic factors are not required.

Remark 5. *For the infinite horizon problem we necessarily include discounting, and the control problem takes the form:*

$$x_t^* = \max_{x_t} \int_0^\infty e^{-\delta t}\eta_t\sqrt{x_t}\,dt, \tag{55}$$

$$\text{s.t.} \int_0^\infty x_t\,dt = X.$$

In this setting we interpret $S(X,\eta,t)$ as the maximum expected contribution obtainable through the use of a disbursal function x_τ for $t \le \tau < \infty$.

Thus $S(X,\eta,t)$ is the maximum expected value of:

$$\int_0^\infty e^{-\delta\tau}\eta_t\sqrt{x_\tau}\,d\tau, \tag{56}$$

$$\text{s.t.} \int_0^\infty x_\tau\,d\tau = X,$$

where

$$\eta_0 = \eta.$$

We are now able to argue from the optimality principle that for any $h > 0$:

$$S(X,\eta,t) = \max_{\xi} E_{t,\eta}\left[\int_t^{t+h} e^{-\delta\tau}\eta_t\sqrt{\xi_\tau}\,d\tau + S\left(X - \int_t^{t+h}\xi_t\,d\tau,\ \eta_{t+h},\ t+h\right)\right] \tag{57}$$

where, as before, ξ_τ is a disbursal function defined for $t \le \tau \le t + h$. But, the expression being maximised is equal to:

$$E_{t,\eta}\left[\int_t^{t+h} e^{-\delta\tau}\eta_t\sqrt{\xi_\tau}\,d\tau\right] + E_{t,\eta}E_{t+h,\eta(t+h)}\left[S\left(X - \int_t^{t+h}\xi_\tau\,d\tau,\ \eta_{t+h},\ t+h\right)\right]. \tag{58}$$

Here it is instructive to examine the definition of $S(X,\eta,t+h)$, which applies to:

$$\int_{t+h}^\infty e^{-\delta\tau}\eta_\tau\sqrt{x_t}\,d\tau. \tag{59}$$

On making the substitution $u = \tau - h$, the integral becomes:

$$\int_t^\infty e^{-\delta(u+h)}\eta_{u+h}\sqrt{x_{u+h}}\,du \tag{60}$$

$$= e^{-\delta h}\int_t^\infty e^{-\delta u}\tilde{\eta}_u\sqrt{z_u}\,du. \tag{61}$$

Noting that apart from the factor $e^{-\delta h}$ which has been taken through the integral sign, we are faced with the same maximisation problem as before, but in the context of a shifted process $\tilde{\eta}_u = \eta_{u+h}$, which is a stochastic process just like η_t defined by an equation analogous to (47) but conditioned by $\tilde{\eta}_t = \eta_{t+h}$, and $z_u = x_{u+h}$ is now the choice variable. Thus

$$S(X,\ \eta_{t+h},\ t+h) = e^{-\delta h}S(X,\ \eta_{t+h},\ t). \tag{62}$$

We thus arrive at the expression to be maximised:

$$E_{t,\eta}\left[\int_t^{t+h} e^{-\delta\tau}\eta_t\sqrt{\xi_\tau}\,d\tau\right] + E_{t,\eta}E_{t+h,\eta(t+h)}\left[e^{-\delta h}S\left(X - \int_t^{t+h}\xi_\tau\,d\tau,\ \eta_{t+h},\ t\right)\right] \tag{63}$$

which has no time increment in the third argument of S. Under these circumstances we need to invoke Itô's rule in a modified format:

$$E_\eta\left[e^{-\delta dt}\,F(\eta+d\eta)\right]=F(\eta)+\left(-\delta F(\eta)+f(\eta)F'(\eta)+\frac{1}{2}\sigma^2(\eta)F''(\eta)\right)dt \quad (64)$$

it being clear that the new term arises from the expansion $e^{-\delta dt}=1-\delta dt$. In our context

$$E_\eta[e^{-\delta dt}S(X+dX,\,\eta+d\eta,\,t)]=S(X,\,\eta,\,t)$$
$$+\{-x\frac{\partial S}{\partial X}-\delta S+f(\eta)\frac{\partial S}{\partial\eta}+\frac{1}{2}\sigma^2(\eta)\frac{\partial^2 S}{\partial\eta^2}\}dt \quad (65)$$

since $dX=-xdt$. But we have $S(X,\eta,t)=\sqrt{X}V(\eta,t)$, thus we obtain the same optimal disbursion law (53), but discounted:

$$x_t=\frac{e^{-2\delta t}\eta_t^2X_t}{V^2(\eta_t,\,t)}\equiv g_tX_t. \quad (66)$$

The equation satisfied by the function $\tilde{V}(\eta)=e^{\delta t}V(\eta,\,t)$ (compare with Section 3) is the ordinary differential equation:

$$0=\frac{\eta_t^2}{2\tilde{V}}-\delta\tilde{V}+f(\eta_t)\frac{d\tilde{V}}{d\eta}+\frac{1}{2}\sigma^2(\eta_t)\frac{d^2\tilde{V}}{d\eta^2}. \quad (67)$$

Remark 6. *(Value of stock remaining)*

Here again $w_t=\dfrac{\tilde{V}}{2\sqrt{X_t}}$ so that the value of the stock remaining is $w_t\cdot X_t=\sqrt{X_t}\,\tilde{V}/2=e^{\delta t}S(X_t,\eta_t,t)/2$, so that the ratio of the value of stock/input to the expected value of its product is β in general.

6.3. Example: An Infinite Horizon Problem when the Market Indicator is Mean Reverting with Reflecting Barriers

We shall assume that the market indicator evolves stochastically as before, and that over long periods of time the indicator is drawn back towards its mean value. The form of specification for mean reversion in (47) that we apply is:

$$f(\eta)=f_0\,(\bar{\eta}-\eta) \quad (68)$$

where f_0 is the speed of reversion to the (market indicator) mean $\bar{\eta}$, and we assume the volatility parameter $\sigma^2=\sigma_0^2$, a constant. We wish to assume that the market indicator is bounded between two barriers, $\eta\in\ [\underline{\eta},\bar{\eta}]$, the economic justification for this being that if the price becomes too high $(\eta=\bar{\eta})$, consumers switch out of consumption of the good, or alternatively if the price becomes too low $(\eta=\underline{\eta})$, there is an exodus of firms. To achieve this goal, we will require that when the process η reaches one of the barriers, it is reflected back (an alternative assumption of absorbing barriers seems less attractive for this problem). This necessitates a rewriting of (47) to include a term that accounts for the reflection. We avoid details of the technicalities by referring to Kushner and Dupois (1992) and remarking that the differential equation for the value function $\tilde{V}(\eta)$ holds between the barriers, while $\tilde{V}'(\eta)=0$ at the barrier.

For our numerical example, if we assume that the market indicator lies in the range $1\le\eta\le 2$, the mean value for η is 1.5. If we assume the speed of reversion f_0 takes the value 2, then we can write the drift for the mean reverting stochastic process to be:

$$f(\eta)=2(1.5-\eta). \quad (69)$$

Further, we assume $\sigma=0.2$ and the rate of interest $\delta=4\%$. In order to solve numerically the differential equation, we now turn to the boundary conditions. We are faced with a two-point boundary value problem. Fortunately, in the present context the solution is unique (see for instance Keller (1992)), and in order to find it we must reduce our problem to an initial value problem specifying say $V(2)$ and $V'(2)$. Let us verify our uniqueness assertion by rewriting the differential equation in the form

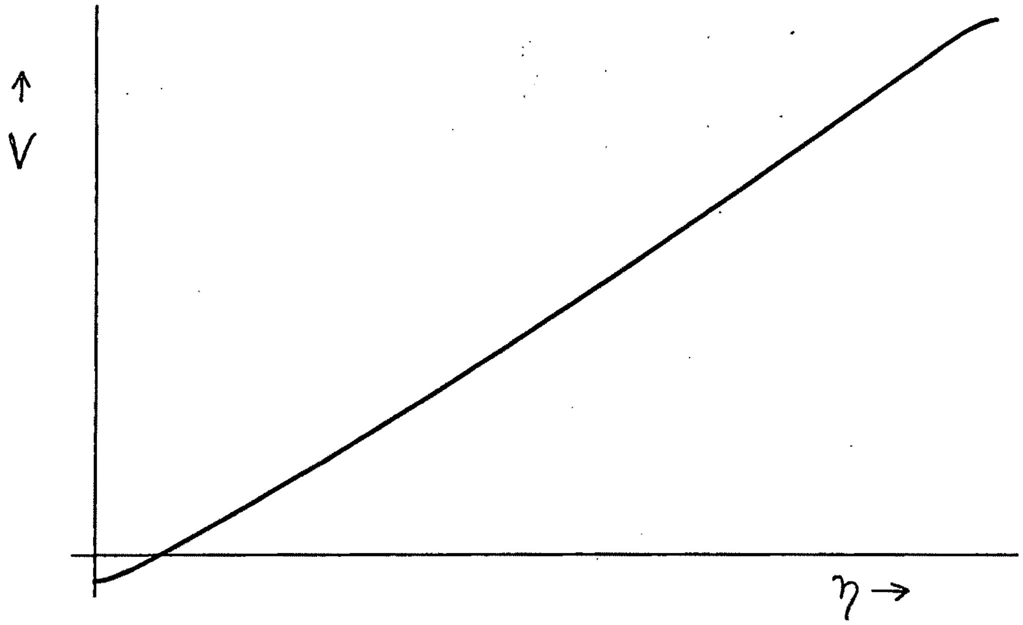
$$V''=F(x,\,V,\,V')\equiv\frac{2}{\sigma^2}(\delta V-f(x-\bar{x})V'-\frac{x^2}{2V}). \quad (70)$$

This equation will have a unique solution, given initial conditions, provided F is uniformly Lipschitz in V and V'. Now observe that since $\eta\ge 1$

$$V(\eta)\ge\max\{\int_0^\infty e^{-\delta t}\sqrt{x_t}dt\ s.t.\ \int_0^\infty x_t=1\}. \quad (71)$$

It is easily checked that the right-hand side is maximised using $x_t=\dfrac{e^{-2\delta t}}{4\lambda^2}$ with λ a constant Lagrange multiplier so that $8\lambda^2\delta=1$ and the maximum is $\dfrac{1}{4\delta\lambda}=\dfrac{1}{\sqrt{2\delta}}$. (For example if $\delta=4\%$ and $\eta\ge 1$, we have $V\ge\dfrac{\sqrt{2}.10}{4}=3.53553$). Moving now to

Figure 3
Graph of V (η)



the boundary values problem we verify that we have

$$\frac{\partial F}{\partial V}=\frac{2}{\sigma^2}(\delta+\frac{\eta^2}{2V^2})>0 \qquad (72)$$

and

$$\left|\frac{\partial F}{\partial V'}\right| = 2\,|\,1.5-\eta\,| \leq 1 \qquad (73)$$

so the latter partial derivative is bounded. Thus the uniqueness theorem applies.

We now need to develop a search procedure for $\tilde{V}(2)$. To obtain a first estimate we observe that there must be a point of inflection in the interval hopefully close to the midpoint and so we hope that $\tilde{V}''(1.5)$ is small. With small values for σ and $\tilde{V}''(1.5)$, we can obtain a guess for $\tilde{V}(1.5)$ from the equation (67):

$$\frac{\eta^2}{2}-\delta\tilde{V}^2+f(1.5)\tilde{V}\tilde{V}'+\frac{1}{2}\sigma^2\tilde{V}\tilde{V}''=0. \qquad (74)$$

Note that $f(1.5)=0$ and assuming $\tilde{V}''$ is small enough, so the final term can be ignored, we have

$$\tilde{V}=\sqrt{\frac{1}{0.04}\times\frac{1.5^2}{2}}\simeq 5.3033 \qquad (75)$$

As a check on this guess, we note that actually we have

$$\tilde{V}^2-\frac{1}{2}\tilde{V}\tilde{V}''-\frac{9\times 25}{8}=0 \qquad (76)$$

and regarding this as quadratic gives a positive root:

$$\tilde{V}\,(1.5)=\frac{\tilde{V}''}{4}+\sqrt{\frac{9\times 25}{8}+\frac{(\tilde{V}'')^2}{16}} \qquad (77)$$

and so we shall not be far off if $\tilde{V}''$ (1.5) is not very large. Since 5.303 is an underestimate, we guess at 5.4. An application of *Mathematica* to the conditions $\tilde{V}(2)=5.4$, $\tilde{V}'(2)=0$ using the NDSolve command soon elicits a more accurate estimate of $\tilde{V}(2)=5.38381351$ and in fact $\tilde{V}(1.5)=5.31398$.

Let us finally consider a detailed interpretation of the above results, so that we understand the intuition, and consider how the results apply to our cost accounting problem. Recall (66) and observe that $\frac{\eta}{\tilde{V}(\eta)}$ is an increasing function; if for the period a better than average market indicator value η is realised, it is optimal to disburse more of the sunk resource in the period. How much more is made precise by solution of the optimality equations characterised here. Furthermore, given Observation 1, we see that for the equivalent decentralised price disbursion mechanism it will be optimal for the centre to set a higher price w_t if the value η_t is better than average; again, the extent is made precise by the optimality equations. The rationale here is that: *'better'*η_t results in more sunk resource (X_t) being disbursed to the period, but that, in turn, this should not be wasted on *'average'* projects and a higher price should be charged so the better (higher-contribution generating) projects receive proportionately more of the resource.

It is also interesting to consider how the precise solutions depend on the parameters of the model. For instance, how will the optimal disbursal rule and associated optimal decentralised price vary for more or less volatile environments? Put simply, how should the knowledge that realisations of the market indicator are very volatile affect the centre's decision-making? The dependence of $\tilde{V}(2)$ on the volatility is listed in Table 1.

Thus as the volatility increases, $\tilde{V}(\eta)$ increases, and thus it is optimal to *decrease* the disbursal level, ceteris paribus. Again, the logic is straightforward; for a very low volatility process, it is more unlikely that the mean reverting indicator process will return to the upper barrier, and hence the disbursal process should take most advantage of this (relatively unlikely) favourable situation at that moment.

We conclude this section with a discussion of the α cost recovery theorem now implemented in a stochastic environment. In Appendix B, a proof of the theorem is presented in which we assume that the $a(t)$ process evolves stochastically. We show that the α cost recovery theorem of Section 3 continues to hold in the revised environment, provided deterministic cost recovery is replaced with *expected* recovery, and hence the relationship between sunk cost and opportunity cost still applies provided we consider *expected* opportunity costs. An interesting new variation that arrives in the stochastic environment is that at some intermediate time, expectations may not have been realised and at issue is what is the expected value of the resource's remaining stock. The lemma in Appendix B establishes that at any time τ, if the remaining stock is X_τ, then the remaining expected cost recovery is the economic value of the stock $w_\tau X_\tau$, where again we interpret w_τ as the opportunity cost. Any divergence between this measure and α times the (remaining) sunk cost can be interpreted as the accounting variance arising as the result of unexpected conditions; thus as in simple materials price variance calculations one could separate out the effect of, for instance, the realized η and the expected $\tilde{\eta}$.

Table 1
Volatility effect on disbursion

σ	$\tilde{V}(2)$
0.2	5.383813
0.3	5.39209
0.4	5.40000

7. Full disbursion theorem

We now show that when η_t is bounded (i.e. assuming reflecting barriers) the following theorem holds for such Weiner models:

Theorem 1. *The stock is fully utilised by the optimal disbursal policy.*

Proof: We begin with the finite horizon case. According to equation (53), we have

$$\frac{dX_t}{dt} = -g_t \cdot X_t \tag{78}$$

with $X_0 = \overline{X}$. Thus

$$X_t = X_0 \cdot e^{-\int_0^t g_\tau \, d\tau}.$$

The stock utilised is equal to:

$$\int_0^1 x_\tau \mathrm{d}_\tau = \int_0^1 g_t \cdot X_0 \cdot e^{-\int_0^t g_t \, d\tau} \, dt = X_0 [-e^{-\int_0^t g_\tau \, d\tau}]_0^1 \tag{79}$$

and so the stock utilised is

$$X_0 (1 - e^{-\int_0^1 g_\tau \, d\tau}).$$

Hence stock is fully utilised if and only if

$$\int_0^1 g_\tau \, d_\tau = \infty. \tag{80}$$

To verify that this is true, we make use of Hölder's inequality:

$$\int_t^1 \eta_t \cdot \sqrt{x_t} \, dt \leq \{\int_t^1 \sqrt{x_t}^2 \, dt\}^{1/2} \cdot \{\int_t^1 \eta_\tau^2 \, d\tau\}^{1/2} \leq \sqrt{X_t} \cdot \{\int_t^1 \eta_\tau^2 \, d\tau\}^{1/2},$$

since evidently by the same argument as in (79) $\int_t^1 x_\tau \, d\tau \leq X_t$. Thus the maximum expected contribution $S(X_t, \eta_t, t)$ satisfies:

$$S(X_t, \eta_t, t) = \sqrt{X_t} V(t, \eta_t) \leq \sqrt{X_t} \cdot E_t [\{\int_t^1 \eta_\tau^2 \, d\tau\}^{1/2}],$$

where E_t denotes expectation as at time t. Let us assume that $1 \leq \eta_\tau \leq \rho$, so

$$\{\int_t^1 \eta_\tau^2 \, d\tau\}^{1/2} \leq \{\int_t^1 \rho^2 \, d\tau\}^{1/2} \leq \rho \sqrt{(1-t)}$$

and consequently

$$V(t,\eta_t)\leq\rho\sqrt{(1-t)}. \tag{81}$$

A comparison with equation (53) gives

$$g_t\geq\frac{1}{\rho^2(1-t)}.$$

We arrive at the expected result:

$$\int_0^1 g_\tau\, d\tau\geq\int_0^1\frac{dt}{\rho^2(1-t)}=\infty. \tag{82}$$

Since $x_t\geq\frac{X_t}{\rho^2}\cdot\frac{1}{1-t}$ there is a certain minimum disbursion at any time period which grows inversely with time to expiry.

In the infinite horizon case, the disbursal policy is:

$$x_t=\frac{e^{-2\delta t}\eta_t^2}{V(\eta_t)^2}\cdot X_t,$$

again in the form

$$x_t=g_t\cdot X_t \tag{83}$$

and the previous analysis goes through mutatis mutandis; in particular we obtain:

$$V\leq\{\int_t^\infty\rho^2e^{-2\delta\tau}\,d\tau\}^{1/2}\leq\frac{\rho e^{-\delta t}}{\sqrt{2\delta}}$$

so that

$$g_t\geq\frac{2\delta}{\rho^2},$$

from which we have:

$$\int_0^\infty g_\tau\, d\tau\geq\frac{2\delta}{\rho^2}\cdot\int_0^\infty d\tau=\infty, \tag{84}$$

just as before. Here the result is driven by the fact that $x_t\geq\frac{2\delta}{\rho^2}X_t$, i.e., a certain fixed proportion of stock remaining is used at any moment.

It is worth noting that a somewhat different argument is needed to verify the full utilisation result in the discrete case discussed in Section 5. With the finite horizon it is evident that all the stock left is utilised in the final period, but if an infinite horizon model is considered, a different reasoning is needed. Letting g_t be regarded as the market indicator we have:

Theorem 2. *If a disbursal policy takes the form $x_{t+1}=g_{t+1}\cdot X_t$ where $0\leq g_t\leq 1$ and g_t takes values in a finite set and has a positive probability of positive values occurring, then for an opening stock $\bar{X}=Td$ (d a constant) the expected value of the stock remaining at time T, $E(X_T)$ tends to zero as $T\to\infty$.*

Proof: Evidently $x_{t+1}=X_t-X_{t+1}$, thus

$$X_t-X_{t+1}=g_{t+1}\cdot X_t,$$

or

$$X_{t+1}=(1-g_{t+1})\cdot X_t.$$

It follows, since we require $X_t\geq 0$, that $g_t\leq 1$, and since we are to have $X_{t+1}\leq X_t$ that $g_t\geq 0$, and this explains our hypothesis that

$$0\leq g_t\leq 1.$$

We conclude that at time $t=T$ we have:

$$X_T=(1-g_T)\cdot(1-g_{T-1})\ldots(1-g_1)\,\overline{X},$$

since $X_0=\overline{X}$. We assumed that the market indicator takes a small number of values relative to the total number of periods. Let us say there are only two values h, l, high and low. Putting $H=1-h$, $L=1-l$, we have

$$X_T=H^kL^{T-k}\cdot\overline{X},$$

where k is the number of high values in $0\leq t\leq T$. If the high value were 1 and were to occur at $t=T$, the stock would be exhausted. Evidently, if $0<l<h<1$ then $0<H<L<1$ and so

$$X_T\leq\overline{X}\cdot L^T\to 0 \text{ as } T\to\infty.$$

Assuming the weaker condition $0\leq l<h<1$ and a positive probability of high markets occurring, we see that for large T the expected stock remaining tends to zero as time progresses. For instance, let us take $\overline{X}=Td$, so that we can allow T to be large, keeping the period average constant at d. Then if h, l are equally likely, we see that

$$E[X_T]=\frac{1}{2^T}\sum_k\binom{T}{k}H^kL^{T-k}\cdot\overline{X}=$$

$$\frac{1}{2^T}(H+L)^T\cdot Td=T\,(1-\frac{h+l}{2})^T\cdot d\to 0 \tag{85}$$

as $T\to\infty$. Clearly this argument extends to general multinomial distributions.

8. Conclusion

We have characterised a typical resource problem faced by organisations. A centre attempts to predict how future external market and internal productivity conditions will evolve. On the basis of these predictions some level of a resource is purchased centrally.[8] Next the resource level is fixed for a period during which the centre then has to evaluate how to disburse directly, *or* set decentralised prices for, the resource over time, given that it is unlikely that the centre's original predictions will be realised exactly.

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[8] It is not difficult to consider the multiple input version of this model with production function $a_tx_t^\beta y_t^\alpha\ldots$

To capture in spirit the nature of this complex real world situation, we have modelled the problem using stochastic optimal control techniques, and identified how the centre can achieve optimal disbursal policies through time. Since in practice we observe the use of cost allocation procedures for such problems, we consider whether such procedures could be optimal. We establish conditions that characterise when it is possible to conclude that such practices guide the taking of optimal (decentralised) consumption decisions. The rationale is based on the commonly proposed assertion that such practices act as a good proxying of opportunity cost.

Our contribution is that we are unambiguous in our identification of what a *good* estimate of opportunity cost is, since we are able to define *exact* (optimal) estimates. Furthermore, we introduce to the literature a formal characterisation of the stochastic resource consumption problem as a Wiener process, which allows us to develop much richer notions of opportunity cost and hence consider more deeply the robustness of any assertion that cost allocations can act as estimators[9] for opportunity cost.

It should be noted that our results do not contradict Hughes' and Scheiner's (1980) earlier formal analysis, which has been a long-established result questioning the economic validity of allocation practices. Our results show (Section 3) that whenever the purchase cost exponent, α, is not equal to unity, *full* cost allocation is non-optimal, since it distorts economic decision-making, as Hughes and Scheiner (1980) established. If our results concerning the desirability of cost allocation were only valid for the case $\alpha = 1$, it may seem reasonable to conclude that they are highly specialised (to the assumption) and non-generalisable. However, we see no reason a priori to restrict attention only to full cost allocation procedures. A potential disadvantage of proposing this less restrictive assumption is that any solutions that we propose may be very complex and hard to develop an intuition for. However, we find this is not the case since, provided the centre allocates α times the cost of purchase of the sunk resource, we are able to establish the optimality of certain cost allocation procedures. This result has the clear and simple intuition that, for instance, when economies of scale exist, with $\alpha < 1$, the externality of centrally purchasing the resource for all divisions simultaneously (for an extended period) should be reflected in the allocation procedures.

Appendix A
A convergence theorem

We consider the sequence defined recursively by

$$A_{n+1} = \sum_{\zeta=1}^{S} p_\zeta \left(a_\zeta^r + A_n^r\right)^{1/r}$$

with $A_0 = 0$. Here $r \geq 1$, for each ζ we have $p_\zeta > 0$ with $\sum p_\zeta = 1$ and the numbers a_ζ are non-negative. We sketch a proof that

$$\frac{A_n^r}{n} \rightarrow \sum_{\zeta=1}^{S} p_\zeta a_\zeta^r.$$

The applications we have in mind are for $\beta = 1/r$ (the Cobb-Douglas exponent in the production function, see Section 3). Thus, with two states ζ, and for example with $\beta = 1/2$, we obtain the recurrence equation of Section 5, viz:

$$A_{n+1} = p_a\sqrt{a^2 + A_n^2} + p_A\sqrt{A^2 + A_n^2}$$

for which the limit formula is therefore

$$\frac{A_n^2}{n} \rightarrow p_a \cdot a^2 + p_A \cdot A^2.$$

The proof given below was obtained in collaboration with Roy O. Davies.

Proof: Before attacking the result in generality, we must first dispose of a number of simple situations. We will assume that at least one of the a_ζ is positive, since otherwise the recurrence reduces to $A_{n+1} = A_n$ and then $A_n = 0$ for all n. Also note that the special case $r = 1$ yields immediately that $A_{n+1} = \left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta\right) + A_n = n \cdot \left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta\right)$ for all n. Similarly, if $S = 1$, the recurrence becomes $A_{n+1}^r = a^r + A_n^r$ and then $A_n^r = na^r$ for all n.

To prove the result in the most general scenario it will suffice to verify that the function

$$f(x) = \left[\sum_{\zeta=1}^{S} p_\zeta \left(a_\zeta^r + x\right)^{1/r}\right]^r - x$$

is strictly increasing for $x \geq 0$, by establishing that $f'(x) > 0$ for $x > 0$. Now

$$f'(x) = r\left[\sum_{\zeta=1}^{S} p_\zeta \left(a_\zeta^r + x\right)^{1/r}\right]^{r-1} \cdot$$

$$\left[\sum_{\zeta=1}^{S} \frac{1}{r} \cdot p_\zeta \left(a_\zeta^r + x\right)^{(1-r)/r}\right] - 1$$

---

[9] Note our discussion of the related work of Miller and Buckman (1987), Dewan and Mendelson (1990) and Balachandran and Srinidhi (1987, 1990) in the first two sections.

so setting $x_\zeta = (a_\zeta^r + x)^{1/r}$ the assertion is equivalent to

$$\sum_{\zeta=1}^{S} p_\zeta x_\zeta^{1-r} > \left[\sum_{\zeta=1}^{S} p_\zeta x_\zeta\right]^{1-r},$$

which is true, because x^{1-r} is a strictly convex function of x. Next, observe by appealing twice to the binomial theorem that as $x \to \infty$ we have

$$f(x) = x\left[\sum_{\zeta=1}^{S} p_\zeta \left(1 + a_\zeta^r/x\right)^{1/r}\right]^r - x$$

$$= x\left[\left(\sum_{\zeta=1}^{S} p_\zeta\right) + \frac{1}{rx}\cdot\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r + O\left(\frac{1}{x^2}\right)\right]^r - x$$

$$= \sum_{\zeta=1}^{S} p_\zeta a_\zeta^r + O\left(\frac{1}{x}\right).$$

We may now conclude from this asymptotic formula that

$$f(0) = \left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta\right)^r < f(x) < \sum_{\zeta=1}^{S} p_\zeta a_\zeta^r.$$

So since $f(A_n^r) = A_{n+1}^r - A_n^r$ we have

$$\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta\right)^r < A_{n+1}^r - A_n^r < \sum_{\zeta=1}^{S} p_\zeta a_\zeta^r,$$

or

$$\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta\right)^r + A_n^r < A_{n+1}^r < \sum_{\zeta=1}^{S} p_\zeta a_\zeta^r + A_n^r.$$

Thus by induction

$$n \cdot \left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta\right)^r \le A_n^r \le n \cdot \sum_{\zeta=1}^{S} p_\zeta a_\zeta^r.$$

In particular, the sequence A_n^r/n is bounded and

$$\limsup \frac{A_n^r}{n} \le \left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right).$$

Of course, since we have assumed that at least one of the numbers a_ζ is positive

$$\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r \neq 0,$$

so, since $A_n^r \to \infty$, we have for a fixed $\varepsilon > 0$ that for all large enough n, say for $n \ge N$,

$$(1-\varepsilon)\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right) < f(A_n^r) = A_{n+1}^r - A_n^r,$$

or

$$(1-\varepsilon)\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right) + A_n^r \le A_{n+1}^r.$$

But this implies for $n \ge N$ that

$$(n-N)(1-\varepsilon)\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right) + A_N^r \le A_n^r.$$

and passing to the limit as n tends to infinity that

$$(1-\varepsilon)\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right) \le \liminf \frac{A_n^r}{n}.$$

The expression on the right is independent of ε, so it now follows that

$$\left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right) \le \liminf \frac{A_n^r}{n} \le \limsup \frac{A_n^r}{n} \le \left(\sum_{\zeta=1}^{S} p_\zeta a_\zeta^r\right).$$

The sequence is thus convergent, with limit as asserted.

Appendix B

The α cost recovery theorem

We need to maximise over X, x_t the expected value of

$$\int_0^T \eta_t x_t^\beta dt - X^\alpha$$

$$s.t. \int_0^T x_t dt - X,$$

where X has been selected from the outset $(t=0)$. Putting $z_t = \frac{x_t}{X}$, we need to find the maximum expected value over X, z_t of

$$\int_0^T \eta_t X^\beta z_t^\beta dt - X^\alpha$$

$$s.t. \int_0^T z_t dt = 1,$$

that is

$$\max_{z,X} E[X^{\beta}\int_0^T \eta_t z_t^{\beta} dt - X^{\alpha}] \tag{86}$$

$$s.t. \int_0^T z_t dt = 1.$$

Now $V(\eta_0, 0)$ is the maximum expected value of $\int_0^T \eta_t z_t^{\beta}\, dt$. The first order condition on X is therefore

$$\beta X^{\beta-1} V(\eta_0, 0) - \alpha X^{\alpha-1} = 0$$

or equivalently

$$V(\eta_0, 0) = \frac{\alpha}{\beta} X^{\alpha-\beta}, \tag{87}$$

yielding a maximum if $\alpha > \beta$. Now observe that $w_t^* = \beta\eta_t \hat{x}_t^{-\frac{1}{s}}$ by equation (16). Thus

$$E[\int_0^T w_t x_t dt] = E[\int_0^T \beta\eta_t \hat{x}_t^{1-\frac{1}{s}}\, dt],$$

since $\beta + \frac{1}{s} = 1$

$$= \beta E[\int_0^T \eta_t \hat{x}_t^{\beta}\, dt]$$

$$= \beta X^{\beta} \mathrm{E}[\int_0^T \eta_t \hat{z}_t^{\beta}\, dt] \tag{88}$$

$$= \beta X^{\beta} V(\eta_0, 0)$$

$$= \beta X^{\beta} \frac{\alpha}{\beta} X^{\alpha-\beta},$$

thus by (87)

$$= \alpha X^{\alpha} \text{ as required.} \tag{89}$$

Actually the calculation yielding (88) gives us the following.

Lemma

At any time τ the remaining expected cost recovery equals the economic *value of the remaining stock.*

Indeed, if at time τ the remaining stock is X_{τ} we have:

$$E[\int_{\tau}^T w_t x_t dt] = \beta X_{\tau}^{\beta} E[\int_{\tau}^T \eta_t \hat{z}_t^{\beta}\, dt] = \beta S(X_{\tau}, \eta_t, \tau) = w_{\tau}.X_{\tau}.$$

Appendix C

An expectations limit theorem

We now prove (41). We need to introduce some temporary notation; for $g(x)$ any function let

$$E_M[g(f)] = \sum p_M(f) g(f).$$

Here $p_M(f)$ is the probability that in M trials f is the frequency of heads and $E_M[g(f)]$ is thus the expected value of $g(f)$ in M trials. We begin with:

Lemma

$$\lim_{M\to\infty} E_M[f_2^2] = p_2^2.$$

i.e. the limiting expectation in M trials of the squared frequency of heads is the squared probability of heads.

Proof. Evidently $E_M[f_2^2] \geq E_M[f_2]^2 = p_2^2$. Now fix any integer l and consider only $l \leq M$. We shall show that

$$\lim_{M\to\infty} E_M[f_2^2] \leq \frac{l}{l-1} \cdot p_2^2.$$

We observe that for $l \leq k \leq M$ we have:

$$\frac{M}{M-1} \leq \frac{k}{k-1} \leq \frac{l}{l-1}$$

since $\frac{k-1}{k} = 1 - \frac{1}{k}$ is increasing wih k. Hence

$$\frac{k}{M} = \frac{k-1}{M-1} \cdot \left\{\frac{k}{k-1} \frac{M-1}{M}\right\} \leq \frac{k-1}{M-1} \cdot \frac{l}{l-1} \cdot \frac{M-1}{M}$$

Observe also that

$$\binom{M}{k} \cdot \frac{k}{M} = \binom{M-1}{k-1},$$

from which it follows that

$$\sum \binom{M}{k} p_1^{M-k} p_2^k \cdot \frac{k}{M} = p_2 \cdot \sum \binom{M-1}{k-1} p_1^{M-1-(k-1)} p_2^{k-1} = p_2.$$

We now compute:

$$E_M[f_2^2] = \sum_{k<l} \binom{M}{k} p_1^{M-k} p_2^k \cdot \frac{k^2}{M^2} + \sum_{k\geq l} \binom{M}{k} p_1^{M-k} p_2^k \cdot \frac{k^2}{M^2}$$

$$\leq \frac{l^2}{M^2} \cdot \sum_{k<l} \binom{M}{k} p_1^{M-k} p_2^k + \frac{l}{l-1} \cdot \frac{M-1}{M} \cdot \sum_{k\geq l} \binom{M}{k} p_1^{M-k} p_2^k \cdot \frac{k}{M} \cdot \frac{k-1}{M-1}$$

$$\le\frac{l^2}{M^2}\cdot\sum_k\binom{M}{k}p_1^{M-k}p_2^k+\frac{l}{l-1}\cdot\frac{M-1}{M}\cdot$$

$$p_2\sum_k\binom{M-1}{k-1}p_1^{M-1-(k-1)}p_2^{(k-1)}\cdot\frac{k-1}{M-1}$$

$$\le\frac{l^2}{M^2}+\frac{l}{l-1}\cdot\frac{M-1}{M}\cdot p_2^2$$

Letting M tend to infinity yields the required result. But the left-hand side is independent of l. So letting $l\to\infty$ gives the result in the Lemma.

Proposition

$$\lim_{M\to\infty}E_M[\sqrt{1+3f_2}]=\lim_{M\to\infty}\sum_k\binom{M}{k}p_1^{M-k}p_2^k\cdot$$

$$\sqrt{1+3k/M}=\sqrt{1+3p_2}.$$

Proof. Write $X_k=\sqrt{1+3k/M}\ge 1$ and $Y=\sqrt{1+3p_2}$. Also for a given M let

$$\alpha_k=\binom{M}{k}p_1^{M-k}p_2^k.$$

Then

$$0\le\sum_k\alpha_k(X_k-Y)^2=\sum_k\alpha_k\left(\frac{X_k^2-Y^2}{X_k+Y}\right)^2$$

$$\le\frac{1}{(1+Y)^2}\sum_k\alpha_k((1+3k/M)-(1+3p_2))^2$$

$$=\frac{9}{(1+Y)^2}\sum_k\alpha_k((k/M)-(p_2))^2$$

$$=\frac{9}{(1+Y)^2}\left[\sum_k\alpha_k(k/M)^2-2p_2\sum_k\alpha_k(k/M)+(p_2)^2\right]$$

$$=\frac{9}{(1+Y)^2}\left[\sum_k\alpha_k(k/M)^2-(p_2)^2\right]\to 0$$

as $M\to\infty$, by the Lemma. Thus

$$\lim_{M\to\infty}\sum\alpha_k(X_k-Y)^2=0,$$

hence

$$\lim_{M\to\infty}\sum\alpha_kX_k^2+Y^2=2Y\cdot\lim_{M\to\infty}\sum\alpha_kX_k,$$

this being justified since

$$\lim_{M\to\infty}\sum\alpha_kX_k^2=\lim_{M\to\infty}\sum\alpha_k\cdot$$

$$(1+3k/M)=1+3p_2=Y^2,$$

exists. Hence

$$2Y^2=2Y\cdot\lim_{M\to\infty}\sum\alpha_kX_k,$$

and so

$$\lim_{M\to\infty}\sum\alpha_kX_k=Y=\sqrt{1+3p_2}.$$

It is clear that the argument may be extended to the case of more than two states to give

Theorem

$$\lim_{M\to\infty}E_M\left[\sqrt{\sum_\zeta\zeta^2f_\zeta}\right]=\sqrt{\sum_\zeta\zeta^2p_\zeta}.$$

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Testing a Model of Cognitive Budgetary Participation Processes in a Latent Variable Structural Equations Framework

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Abstract—Previous accounting research has suggested that subordinate participation in the budgetary process has two cognitive aspects: (1) participation enhances budget quality, and hence the utility of budgets, by allowing subordinates to introduce private knowledge into the budgetary process, and (2) participation enables subordinates to obtain information that is relevant to performing their jobs. This study tests a model that encompasses both cognitive aspects of budgetary participation. Data were gathered with a questionnaire distributed to managers from a variety of different national origins who were working in many different global locations. The data were analysed with latent variable structural equation modelling, which provides several advantages over more conventional analytic methods generally used in budgetary participation and other behavioural accounting research. The results indicated that participation enhances budget quality and that budget quality, in turn, has a positive effect on budget utility. Participation was also found to have a direct and positive effect on job-relevant information. The results failed to support a proposed indirect effect of participation on job-relevant information through the enhancement of budget quality.

1. Introduction

An espoused benefit of participation in organisational decision-making is its capacity to enhance the flow and use of important information within the organisation (Miller and Monge, 1986). Two distinct cognitive aspects of participation are posited to be at work. First, participation may contribute to higher quality decisions because it allows subordinate employees to introduce private knowledge into the decision-making process (e.g., Locke and Schweiger, 1979). Subordinates know more about many aspects of their jobs than anyone else, and participation provides an avenue to communicate this knowledge to organisational decision-makers. Second, participation may allow subordinates to obtain information that is relevant to performing their jobs (e.g., Campbell and Gingrich, 1986; Earley and Kanfer, 1985). For instance, during the interactions with superiors that typify much of participative decision-making, subordinates can ask questions to clarify goals, work strategies, conditions in the work environment, and other factors that are salient to their jobs.

Accounting researchers have devoted much attention to examining subordinate participation in the context of budgetary decision-making. This work has generally focused on attitudinal and behavioural consequences of budgetary participation (e.g., Milani, 1975; Kenis, 1979) and on variables that moderate participation's effects (e.g., Brownell, 1981; Mia, 1989; Dunk, 1993). However, relatively little empirical evidence exists concerning the cognitive processes by which budgetary participation works. In fact, only one study to date (Kren, 1992) has directly tested a model of cognitive budgetary participation processes.

One purpose of the present study was to test a model of budgetary participation that encompasses both cognitive aspects of participative decision-making. Figure 1 displays the proposed model. The upper path of the model indicates that budgetary participation enhances budget quality which, in turn, leads to greater budget utility. The lower path of the model indicates that budgetary participation leads directly to improved job-relevant information. Finally, the model indicates that budgetary participation also has an indirect effect on job-relevant information through its enhancement of budget quality. The model was tested with questionnaire data gathered from organisational

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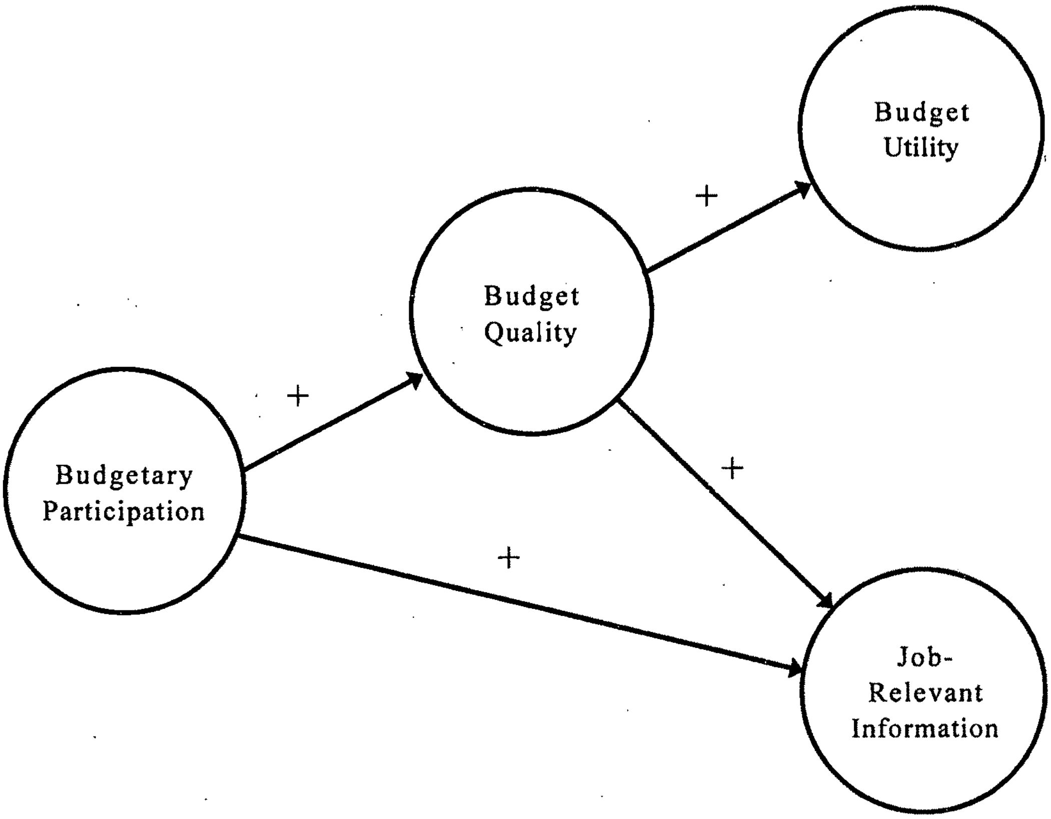
Figure 1
Model tested in the study



managers, who provided assessments of their own levels of budgetary participation and job-relevant information, and evaluations of the quality and utility of the budgets established for their responsibility centres.

A second purpose of the study was to present a systematic analytic framework based on latent variable structural equation modelling that can be used by budgeting and other accounting researchers whose variables of interest are measured with perceptual scales. Latent variable structural equation modelling is increasingly preferred over more traditional analytic methods for examining relationships between latent variables measured by perceptual scales and the measurement properties of these scales (e.g., Anderson and Gerbing, 1988; Bagozzi et al., 1991).

2. Theoretical and empirical foundations

Support for a positive linkage from budgetary participation to budget quality is extensive, but is based on theory or conjecture rather than empirical evidence. (A high-quality budget is one that accurately represents future state conditions in the work environment (Chalos and Haka, 1989).) For example, Murray (1990:111), in commenting on cognitive aspects of budgetary participation, suggested that '...more correct budget levels may result from a superior receiving local information ....' Daroca (1984) proposed that upper-level managers may base budget decisions on unfounded assumptions or insufficient information if they ignore the insights of lower-level employees, which can be elicited through budgetary participation. Hopwood (1976) theorised that the possession of relevant budget information is important for achieving high-quality budgets, and that participation will enhance budget quality if subordinate employees have relevant information not possessed by their superiors. Swieringa and Moncur (1975:3) concluded that '[g]reater participation in the budget-setting process is often associated with the benefits of increasing the likelihood of high-quality budgets....'

Participation also has the potential to affect budget quality in a negative manner. Subordinates who participate in establishing their own budgets may bias the private information they communicate to budgetary decision-makers, so as to obtain performance targets that understate expected performance, or resource distributions that exceed expected needs (e.g., Lukka, 1988). To the extent that such budgetary slack is present, the budget will not accurately reflect future state conditions in the work environment and will therefore be of lower quality. However, empirical research has generally failed to support a positive link between budgetary participation and budgetary slack (e.g., Osni, 1973; Merchant, 1985; Dunk, 1993).

Notwithstanding its uncertain effect on budgetary slack, we propose that budgetary participation will enhance budget quality because it provides subordinates with an opportunity to communicate relevant private information to budgetary decision-makers. Because subordinates have the most intimate knowledge of their own jobs, such information may result in a budget that is a more accurate representation of future state conditions in the work environment. As discussed above, no previous studies have tested empirically this linkage between budgetary participation and budget quality.

A higher quality budget, in turn, is proposed to have more utility for the managers to whom it applies. Budgets authorise control over scarce organisational resources, provide targets to motivate and channel managers' efforts toward organisational goals, and serve as a basis for planning and decision-making (Chow et al., 1988; Lukka, 1988). To the extent that the budget accurately portrays future state conditions, it is likely to be a useful tool for managers in carrying out their jobs. For example, a high-quality budget is more likely to provide managers with an appropriate level of work resources for their responsibility centres. In addition, such a budget will better specify performance targets, which may enhance congruence between the managers' efforts and organisational goals. A high-quality budget also provides managers with a more appropriate basis for planning in important operational areas, such as facilities, personnel and purchasing.

Several previous budgeting studies have indicated that participation leads to more useful budgets (e.g., Kenis, 1979; Merchant, 1981; Govindarajan, 1986). However, these studies have not addressed the process by which this phenomenon takes place. The present model suggests that budgetary participation results in greater budget utility because it allows subordinates to introduce private information into the budgetary process, thereby enhancing the budget's quality.

Taken together, the proposed linkages from budgetary participation to budget quality and budget quality to budget utility lead to the following hypothesis:

H1: Budgetary participation has an indirect and positive effect on budget utility, whereby participation has a direct and positive effect on budget quality, and budget quality has a direct and positive effect on budget utility.

A positive linkage from budgetary participation to job-relevant information is supported by previous empirical work. In a direct examination of this relationship, Kren (1992) found that budgetary participation was associated with greater job-relevant information, which, in turn, was associated with higher job performance. Mia (1989) reported that budgetary participation had the strongest positive relationship with job performance when job difficulty was high. He attributed this interactive effect of participation and job difficulty to the opportunity that participation provides to subordinates to obtain and process additional information about their jobs.

Chenhall and Brownell (1988) found that budgetary participation was associated with lower role ambiguity, which, in turn, was associated with higher job satisfaction and job performance. In explaining these phenomena, Chenhall and Brownell speculated that budgetary participation enables subordinates to obtain information that clarifies role expectations, methods for fulfilling role expectations, or the consequences of role performance.

We propose that budgetary participation leads directly to improved job-relevant information. Participation provides an opportunity for, and motivates subordinates to, interact with people who can provide insight into work environments, performance goals, task strategies and other issues that have an important impact on job performance. These sources of job-relevant information include not only supervisors, but also peers, subordinates and staff personnel. As noted previously, Kren (1992) provided direct empirical support for this proposed relationship between budgetary participation and job-relevant information.

H2: Budgetary participation has a direct and positive effect on job-relevant information.

We also propose that budgetary participation enhances job-relevant information indirectly through its positive effect on budget quality. The outcome of the budgetary decision-making process —the finalised budget—is itself a source of job information for employees. For example, the budget conveys information concerning expected performance and restrictions on resource expenditures. To the extent that budgetary participation leads to a budget that is a better representation of future state conditions, it may result in improved job-relevant information. This proposed indirect linkage between budgetary participation and job-relevant information has not been examined in prior budgeting research.

H3: Budgetary participation has an indirect and positive effect on job-relevant information, whereby participation has a direct and positive effect on budget quality and budget quality has a direct and positive effect on job-relevant information.

3. Method

3.1. Subject and Procedures

Questionnaire data from 95 organisational managers were used in the study. Forty-four of the subjects were attending a 10-week executive development programme sponsored by a major European university, and 36 had previously attended the programme. The remaining 15 subjects were five managers at each of three separate companies, who were selected at random from questionnaires distributed by former programme students. The number of questionnaires returned from each of these companies was 32, 40, and 42 respectively. Only five subjects were selected from each company so that company-specific factors would not have an undue influence on the study's results. No more than six subjects came from any given organisation, and most subjects were their organisation's sole representative in the sample.

The sample contained people from a broad spectrum of national cultures, with subjects originating from more than 20 countries in Europe, Africa, the Middle East, the Far East, North America and South America. Subjects also held assorted job titles—for example, director of client services, plant manager, manager of electrical engineering, support services manager, finance and portfolio manager, research and development manager, vice president of human resources—that suggest diversity with respect to functional area and hierarchical level within their organisations.

To assess the type of budget targets the subjects were responsible for, they were asked about the extent to which (a) their budget included revenue targets, and (b) their budget included cost targets (each item scored 1 to 7). The mean for the first item was 5.41 (standard deviation = 1.84), with 67% of the subjects responding above the midpoint. The mean for the second item was 5.56 (S.D. = 1.56), with 80% of the subjects responding above the midpoint. These responses indicate that, on the whole, the subjects had substantial budget responsibility for both revenues and costs.

3.2. Measures

Budgetary participation was measured with the three-item scale used by Kren (1992), which is based on items developed by Milani (1975). The items are: (1) 'To what extent are you involved in setting all portions of your budget?', (2) 'The budget is not finalised until I am satisfied with it', and (3) 'To what degree is your opinion an important factor in setting your budget?'. Kren reported a reliability coefficient for the scale of 0.85 and presented the results of an exploratory factor analysis that indicated the items' load on a single factor. Each item was measured on a seven-point scale (scored 1 to 7), with higher values on the item scales indicating greater budgetary participation.

Budget quality was measured with a scale developed by the authors. Five items on the questionnaire were intended to measure this construct. However, an exploratory factor analysis indicated that, while four of the items had loadings of 0.71 or greater on a common factor, the loading for the fifth item was only 0.49. Because the analytic procedures used in the present study generally work best when there are three or four items per scale, this fifth item was excluded from the final scale. The four items selected for the scale are: (1) 'The quality of the information presented in my budgets is superb', (2) 'My budgets are informative', (3) 'Budgets accurately reflect my situation', and (4) 'Budgets provide me with dependable information'. Each item was measured on a seven-point scale (scored 1 to 7), with higher values on the item scales indicating higher budget quality.

Budget utility was measured with a scale comprising the following three items: (1) 'The budget enables me to keep track of my success as a manager', (2) 'The budget enables me to be a better manager', and (3) 'The budget enables me to plan activities in my unit'. The first two items were developed by Swieringa and Moncur (1975) and were both included in scales used by Kenis (1979), Merchant (1981), Govindarajan (1986), and Chenhall (1986). The third item was developed by Govindarajan (1986). Each item was measured on a seven-point scale (scored 1 to 7), with higher values on the item scales indicating that the budget has more utility.

Job-relevant information was measured with a three-item scale used by Kren (1992), which was adapted from O'Reilly's (1980) information overload index. The items are: (1) 'I am always clear about what is necessary to perform well on my job', (2) 'I have adequate information to make optimal decisions to accomplish my performance objectives', and (3) 'I am able to obtain the strategic information necessary to evaluate important decision alternatives'. Kren reported a reliability coefficient of 0.72 for the scale and presented the results of an analysis that indicated the items load on a single factor. Each item was measured on a seven-point scale (scored 1 to 7), with higher values on the item scales indicating greater job-relevant information.

4. Analysis and results

4.1. Descriptive Statistics

Table 1 presents ranges, means, standard deviations, Pearson correlation coefficients and alpha internal reliability coefficients based on summed-item measures of the variables in the study. The correlations ranged from 0.38 to 0.70, indicating generally moderate correlations between the variables. All the alphas, which ranged from 0.75 to 0.82, exceeded the minimum value of 0.70 that Nunnally (1978) considered to be acceptable.

4.2. Latent Variable Structural Equation Modelling

Prominent studies (Brownell and McInnes, 1986; Chenhall and Brownell, 1988; Kren, 1992) that have previously tested budgetary participation process models have, like the present study, relied on perceptual scales to measure their variables. These studies have summed the items composing each scale and used that sum as a single indicator of the underlying latent variable the scale is supposed to represent. The coefficients of the paths between the latent variables in the model were then estimated with path analysis (cf. Billings and Wroten, 1978). Path analysis recognises that the total effect of any variable on another variable with which it is linked in the model is composed of its direct effect (which is the path coefficient) and its indirect effect by way of other variables in the model. For example, in testing the present model, the total effect of budgetary participation on job-relevant information is composed of both its direct effect and its indirect effect through budget quality, while the total effect of participation on budget utility is composed of only its indirect effect through budget quality.

The single-indicator approach to path analysis used in these previous studies assumes there is no random measurement error in the scale items (i.e., it assumes the scales have perfect reliability). If random measurement error is present, however, measures of association (e.g. path coefficients, correlation coefficients) between latent variables measured with single indicators will generally be attenuated (Bagozzi et al., 1991). Thus researchers may fail to support relationships between latent variables that do, in fact, exist.

An assumption of perfect reliability is not appropriate in the present study, as all four scales have alpha coefficients of 0.82 or lower. Therefore, we used latent variable structural equation modelling as our analytic method. Latent variable structural equation analysis allows multiple indicators of latent variables and thereby adjusts for the attenuation effects of random measurement error. An added benefit of latent variable structural equation modelling is that it provides a large amount of diagnostic information about the measurement properties of perceptual scales.

4.3. Measurement Model

The first step of our data analysis involved developing a *measurement model.* This is a set of linear structural equations that relate the scale items to the latent variables they are supposed to be measuring. In the measurement model, each scale item was proposed to be an indicator of, or 'load' on, only its associated latent variable (budgetary participation, budget quality, budget utility, or job-relevant information), and these four factors were proposed to be correlated. Because the measurement model specifies in advance the items that should load on each factor, it serves as a basis for confirmatory factor analysis (Long, 1983). Confirmatory factor analysis is in contrast to the

Table 1
Ranges, means, standard deviations, correlations and internal reliabilities

Variable	*Actual (possible) range*	*Mean*	*S.D.*	*1*	*2*	*3*	*4*
1. Budgetary participation	6-21 (3-21)	16.30	3.41	0.75			
2. Budget quality	6-26 (4-28)	19.38	4.46	0.63	0.80		
3. Budget utility	3-21 (3-21)	14.98	3.80	0.45	0.69	0.82	
4. Job-relevant information	4-21 (3-21)	16.49	3.18	0.60	0.56	0.38	0.82

Note: All correlations are significant at $p<0.01$. Alpha internal reliability coefficients are shown on the diagonal.

more familiar exploratory factor analysis, where researchers seek to identify the set of factors that underlie a group of items and items are permitted to load on all of the factors.

To estimate the factor loadings and factor correlations for the proposed four-factor measurement model, we analysed the covariance matrix for the 13 scale items with the LISREL 8 structural equation computer program (Jöreskog and Sörbom, 1993). LISREL is the most widely-used of several similar programs for conducting latent variable structural equation modelling. We selected a maximum likelihood estimation method, which has been found to provide good parameter estimates even if the data deviate moderately from a normal distribution (Chou and Bentler, 1995).

The top of Table 2 presents LISREL factor loadings and derivative statistics, and the bottom of Table 2 displays LISREL correlations. As would be expected, given that LISREL corrects for the attenuation caused by random measurement error, the LISREL correlations are each higher than the corresponding correlations in Table 1, which are based on summed-item scales. Although all four scales had alpha reliability coefficients that exceed the customary 0.70 cut-off, the effects of random measurement error on several of the correlations are dramatic. For example, the correlation between budgetary participation and job-relevant information increased by 0.2 (from 0.6 to 0.8) after adjusting for random measurement error. The increases in the other five correlations ranged from 0.06 to 0.16.

4.4. *Convergent and Discriminant Validity*

Accounting researchers using perceptual measures have typically relied on internal reliability and correlation coefficients and, in some cases, exploratory factor analysis, to support the convergent and discriminant validity of their scales (e.g., Brownell and McInnes, 1986; Chenhall and Brownell, 1988; Kren, 1992). Convergent validity is the degree to which the items comprising a given scale are measuring the same underlying latent variable, and discriminant validity is the degree to which

Table 2
Results of confirmatory factor analysis

Factor and items	*Standardised loading*[a]	*Composite reliability*	*Variance extracted estimate*
Budgetary participation		0.78	0.55
1	0.56		
2	0.74		
3	0.88		
Budget quality		0.81	0.51
1	0.75		
2	0.63		
3	0.69		
4	0.78		
Budget utility		0.84	0.63
1	0.67		
2	0.84		
3	0.86		
Job-relevant information		0.82	0.61
1	0.74		
2	0.81		
3	0.79		

Factor	*Correlations*[b,c] 1	2	3	4
1. Budgetary participation	1.00			
2. Budget quality	0.74 (0.07)	1.00		
3. Budget utility	0.51 (0.10)	0.81 (0.06)	1.00	
4. Job-relevant information	0.80 (0.06)	0.70 (0.08)	0.45 (0.10)	1.00

[a] All standardised loadings are significant at $p<0.01$
[b] The correlations are adjusted for random measurement error in the scales.
[c] Standard errors are shown parenthetically.

each scale is measuring a separate latent variable. Confirmatory factor analysis with latent variable structural equation modelling provides more complete information about convergent and discriminant validity than do these conventional indices.

An important overall indicator of the measurement properties of perceptual scales is the fit of the measurement model to the data. LISREL provides a chi-square statistic to assess the overall fit of a structural equation model. The chi-square for the proposed four-factor measurement model was not significant ($X^2[59]=75$, $p>0.08$). As chi-square is really a 'badness' of fit measure, this non-significant value indicates that the model had a good overall fit to the data from a statistical standpoint. Generally, non-significant chi-squares are difficult to obtain, even for many structural equation models that have a good fit from a practical standpoint (Bentler and Bonett, 1980). Therefore, alternative measures of fit have been developed (cf. Gerbing and Anderson, 1993). One such measure provided by LISREL, the comparative fit index (CFI), has been recommended by Gerbing and Anderson (1993) as the best available fit index for structural equation models. The proposed four-factor measurement model had a CFI of 0.97, which exceeds the minimum 0.9 minimum value for satisfactory fit (Bentler and Bonett, 1980). The chi-square and CFI values indicate that the proposed four-factor measurement model had a good fit to the data from both a statistical and practical standpoint, which supports both the convergent and discriminant validities of the four scales.

Three indices from the confirmatory factor analysis provide specific support for the convergent validity of the scales. The standardised factor loadings, which are indicators of the degree of association between a scale item and a factor, were each highly significant, with t-values ranging from 5.52 to 9.98. Composite reliability, which is derived from the factor loadings (cf. Netemeyer et al., 1990), and is analogous to the alpha internal reliability coefficient, was 0.78 or greater for each scale, indicating that the items comprising each scale are highly correlated with one another. Each of the variance-extracted estimates, which are also derived from the factor loadings (cf. Netemeyer et al., 1990), and represent the amount of variance captured by a latent variable in relation to the amount of variance due to random measurement error, exceeded the minimum level of 0.5 recommended by Fornell and Larcker (1981).

Two tests suggested by Anderson and Gerbing (1988) provided specific evidence of the discriminant validity of the scales. First, the proposed measurement model was compared on the basis of chi-square with alternative models in which one of the six pairs of factors was assumed to be perfectly correlated (i.e., the correlation was fixed at 1.0). For each of the six pairs of factors, the chi-square of the proposed model was significantly ($p<0.05$) less than the chi-square of the constrained model, which indicates that the two factors are not perfectly correlated and thus supports the discriminant validity of the scales. Second, a confidence interval (plus or minus two standard errors) was computed for each of the six factor correlations. None of the six correlations had a confidence interval containing 1.0, which again indicates that none of the pairs of factors is perfectly correlated and further supports the discriminant validity of the scales.

An important quality when assigning meaning to scales is that each scale item is unidimensional, or associated with only one factor (Anderson and Gerbing, 1988). Unidimensionality may be a particular concern in the present study because budget quality and budget utility are closely-related concepts, and some of the items comprising each scale may, in fact, also load on the other concept. Unidimensionality can be assessed in confirmatory factor analysis by looking at the modification indices that LISREL computes for factor loadings. Each modification index indicates the change in chi-square of the model if a given scale item is allowed to load on a factor other than the one with which it is associated in the model. Each of the 38 modification indices pertaining to factor loadings was less than the 5.0 cut-off suggested by Marsh and Hocevar (1985), indicating that the overall chi-square fit of the measurement model would not substantively improve by allowing items to load on more than one factor and thereby supporting the unidimensionality of the items.

We believe the results of the confirmatory factor analysis support the conclusion that the items within each scale are measuring a single latent variable, and that each scale is measuring a separate latent variable.

4.5. Hypothesis Testing

To test the study's hypotheses, the proposed four-factor measurement model was combined with a *structural model* in which the four latent variables have the relationships displayed in Figure 1. Whereas the measurement model specifies relationships between the scale items and their underlying latent variables, the structural model specifies relationships between the latent variables. Incorporating the measurement model with the structural model allows the structural model's path coefficients to be adjusted for the effects of random measurement error in the scale items. As noted earlier, traditional path analysis using single-indicator measures assumes no random measurement error, and thus the path coefficients between latent variables will be underestimated.

Parameter estimates for the combined measurement-structural model were again computed with

Table 3
Standardised direct effects, indirect effects and total effects

Linkage	*Direct effect*	*Indirect effect*	*Total effect*
Participation to budget quality	0.72**	—	0.72**
Participation to budget utility	—	0.56**	0.56**
Participation to job-relevant information	0.65**	0.15	0.80**
Budget quality to budget utility	0.78**	—	0.78**
Budget quality to job-relevant information	0.20	—	0.20

**Significant at $p<0.01$.

a maximum likelihood analysis of the covariance matrix for the 13 scale items. One loading for each factor was fixed at 1.0 so that the four factors were on a common scale (MacCullum, 1995).

Table 3 displays the standardised direct effect, indirect effect and total effect for each proposed linkage between latent variables in the model. The direct effects indicate that the direct paths proposed in Figure 1 were positive and significant, with one exception: the path from budget quality to job relevant information, while positive, was not significant. Since latent variable structural equation modelling was used to estimate this path coefficient, we have assurance that the failure to find significance is not attributable to the attenuation effects of random measurement error. Had we relied on traditional path analysis using single-indicator measures, we would not have this assurance.

The indirect effect of participation on budget utility through budget quality was positive and significant, which supports H1. The positive and significant direct effect of participation on job-relevant information supports H2. H3 is not supported, however, as the indirect effect of participation on job-relevant information through budget quality was not significant.

Traditional path analysis provides no overall indices of how well a structural model fits the data. This information is important, however, because a model for which the proposed paths between latent variables have been supported may still have a poor fit to the data and thus not be valid. Our structural equation analysis does provide evidence to support the fit of the model: chi-square was non-significant ($X^2[61]=77$, $p>0.08$) and CFI exceeded the minimum acceptable value of 0.9 ($CFI=0.97$).

Nor does traditional path analysis provide information about the viability of direct paths between latent variables that are excluded from the model. For example, while the present model does not include a direct path from budgetary participation to budget utility, or between budget utility and job-relevant information, it would be useful to know if the inclusion of any of these paths would lead to a better-fitting model. Modification indices that LISREL computed for these excluded paths were each less than the 5.0 cut-off (Marsh and Hocevar, 1985), indicating that the chi-square fit of the model would not substantively improve by adding any of the paths to the model. This latter result provides further evidence that budgetary participation affects budget utility solely through an indirect effect on budget quality, and that budget utility and job-relevant information do not affect one another.

6. Discussion

The present study was motivated by the general proposition that subordinate participation in the budgetary process enhances the exchange of information in organisations. The results support two distinct cognitive aspects of budgetary participation. First, and consistent with previous empirical work, budgetary participation was found to have a direct and positive effect on the participant's job-relevant information. Participation provides subordinate employees with the opportunity, and motivation, to solicit important information about their jobs from superiors and other parties in the organisation.

Second, the present results provide empirical support for a cognitive aspect of participation that previous budgeting literature has only theorised to exist—namely, that budgetary participation enhances the budget's quality. Participation allows subordinates the opportunity to introduce private knowledge into the budget, thereby allowing for better estimates of future state conditions. Support for this relationship between budgetary participation and budget quality also provides some further indirect evidence that participation does not lead to budgetary slack: the presence of significant amounts of budgetary slack is inconsistent with a high-quality budget.

A better quality budget, in turn, was found to be of greater utility to the managers to whom it applied. A budget that reflects accurate estimates of future conditions is likely to provide managers with better allocations of organisational resources and is a more appropriate tool for directing job-related efforts and planning organisational activities. Taken together, the direct effects of budgetary participation on budget quality, and budget quality on budget utility, indicate that budgetary participation improves budget utility indirectly through an intervening effect on budget quality. Although previous research has indicated a positive relationship between budgetary participation and budget utility, the present study is the first to provide evidence on the process by which this phenomenon takes place.

The study failed to support a proposed indirect effect of budgetary participation on job-relevant information by way of enhancing budget quality. This finding, combined with the support for a direct effect of participation on job-relevant information, suggests that while participating employees derive important information about how to do their jobs from their meetings with other budget players, the finalised budget provides them with no incremental job-relevant information. This phenomenon may occur because all the salient job-related information that will ultimately be reflected in the budget is gleaned by the participating employees prior to the budget's formal approval and implementation. However, to the extent that their participation results in a higher quality budget, the job-relevant information of other employees who are subject to the same budget but had no opportunity to participate is likely to be enhanced.

Future budgeting research should focus on other outcomes of the cognitive participation processes found in the study. Particularly important outcomes would include the participating employee's individual job performance and the performance of the organisational sub-unit for which the budget was developed. Furthermore, budgeting researchers should investigate factors that may moderate the strength of these cognitive processes. For example, when work environments are relatively static, subordinate employees may hold little private knowledge that is relevant for setting the budget, and budgetary participation may have little effect on budget quality. Also, Mia's (1989) results suggest that when job difficulty is low, subordinate employees may gain little job-relevant information as a result of participating in the budgetary process.

The latent variable structural equation modelling used here provides several advantages over more conventional analytic methods generally used in behavioural accounting studies. By using the items in each scale as multiple indicators of the underlying latent variable, the correlations and path coefficients between the latent variables were adjusted for the effects of random measurement error in the items. Criteria such as chi-square and CFI were available to assess the overall fit of the measurement and structural models to the data. Also, a large amount of diagnostic information (e.g., variance-extracted estimates, factor loadings, modification indices) was available to assess the convergent and discriminant validity of the scales. Although not relevant to the present study, latent variable structural equation modelling also allows for reciprocal (i.e., two-way) relationships between latent variables. Furthermore, researchers can use these methods to test whether the parameter estimates of measurement or structural models vary across diverse groups of subjects (e.g., Sawyer, 1992; Rahim and Magner, 1995).

Despite the advantages offered by the latent variable structural equation analytic methods, the present study is subject to several limitations and the results should be interpreted in the light of these potential weaknesses. First, the structural model implies a certain casual ordering between the constructs of interest, which cannot be proved with the cross-sectional data used in this study. Second, the variables were measured through employee perceptions. With respect to cognitive budgetary participation processes, however, it is the objective level of participation, budget quality and job-relevant information that is important. Third, aspects of how we obtained our sample may limit the extent to which the results can be generalised to other managers. Because we used a convenience sample and because some of the people who received the questionnaire did not return it, our results may be influenced by factors specific to the respondents. Finally, although the psychological scales demonstrated adequate convergent and discriminant validity, one cannot be assured that they address the concept that they are intended to address.

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Inflation, Taxation and the Valuation of Shares

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Abstract—A share valuation model is developed that takes account of the possibility of shareholding periods extending beyond one year, income taxes, capital gains taxes paid on realised gains and indexation for inflation. For an infinite dividend series, an optimal shareholding period is derived, which is shown to be related to the level of the after-tax risky rate, discounted at the growth rate, vis-à-vis the after-tax riskless rate, deflated for the general rate of inflation. In turn, this determines whether or not the value of the share is indifferent to the capital gains tax rate and the rate of inflation.

1. Introduction

It is widely recognised that there are different ways of valuing shares, the usual methods being based on either dividends, earnings or assets (Ashton, 1995). The chosen approach depends on a number of factors, including whether the shares represent minority or controlling interests, and whether or not the company is quoted. Indeed, such knowledge is reflected in the learning outcomes for the 'Business Planning and Finance' paper for the Institute of Chartered Accountants in England and Wales' intermediate examination. In particular, candidates are required to describe the implications of taxation for dividend policies. These learning outcomes are a reflection of the importance to practising chartered accountants, who are authorised to carry on investment business under the Financial Services Act 1986, as well as to finance directors and corporate finance specialists. Furthermore, in a survey published in this journal (Herbert and Wallace, 1996), it is revealed that the most important topic UK chief financial officers would put on the research agenda would be the influence of tax laws on financial decision-making.

In the financial modelling literature there are surprising gaps in important issues, such as how should a share valuation model be adjusted for realistic tax effects? These include the influences of indexation for inflation on the capital gains tax resulting from the share disposal. Of course, there have been some attempts to model capital gains tax effects. In particular, the author will review a model by O'Brien (1991) that does include capital gains tax, but assumes only a one-year shareholding period and no indexation; which is, of course, appropriate for a US-style tax system. In this paper there are two principal objectives. First, O'Brien's model will be extended to deal with the possibility of longer shareholding periods, as well as indexation. Second, the issue of an optimal shareholding period will be addressed. This, too, is an area that appears to have been largely neglected, yet is important in tax planning.

2. Background and plan

In spite of gaps in the literature, the UK environment has been a fruitful area for studying tax effects on dividend policy because of the changes over the years in the personal and corporate tax systems. Although Menyah (1993) did not find support for the tax-induced dividend clientele hypothesis in his study of the ex-dividend pricing of equities from 1955 to 1984, Chui, Strong and Cadle (1992) discovered, for 1955 to 1983, that when companies suffering from advance corporation tax set-off exhaustion were excluded, the hypothesis that tax coefficients were the same across three different tax regimes was rejected. Crossland, Dempsey and Moizer (1991) have also supported the view that UK tax clienteles exist. Also, Chang and Rhee (1990) found a relationship between leverage and dividend ratios, based on a study of 508 US firms, using 19-year averages. Zodrow (1991) discusses alternative views of whether dividend taxes affect marginal investments, financed by retentions, and the empirical evidence, while Rutterford (1994) reviews dividend policy in the light of tax and non-tax issues, including the agency and signalling theories.

By definition, models are abstractions from reality. Therefore all models, including the one in this paper, can be criticised as being unrealistic. In building share valuation models it is frequently assumed that: retentions are subject to capital gains tax, e.g., Rickwood and Groves (1979) and Ashton (1989); and/or shares are held for one period, e.g., Brennan (1970) and Clubb and Doran (1992); and/or capital gains taxes are paid on accrued gains, e.g., Auerbach (1979). Of course, these assumptions are closely related.

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Haugen and Heins (1969) and Gordon and Gould (1978), for example, have assumed that taxes on gains are levied each year. Although they take an infinite dividend series, each shareholding period is for one year only. Assuming a constant annual compound rate of growth in dividends, the intrinsic value of a share is given by the following year's income tax adjusted dividend, divided by the difference between the after-personal tax cost of equity and the capital gains tax adjusted growth rate. Specifically, the dividend, D_1, is multiplied by a factor of one minus the dividend tax rate, t_d, while the growth rate, g, is multiplied by a factor of one minus the capital gains tax rate, t_g. In a model that also assumes that taxes on gains are levied each year, based on a shareholding period of only one year, O'Brien (1991) has argued that the deduction, for capital gains tax purposes, for the original share price is known when the share is acquired and therefore should be discounted at the riskless rate, r. By contrast he discounts risky cash flows at the rate k. Therefore, using component discounting he demonstrates that the current share price, P_0, is given by:

$$P_0 = D_1(1-t_d)/\{[k - t_g\,(k-r)/(1+r)] - g(1-t_g)\} \qquad (1)$$

In this paper, different modelling assumptions are employed. First, capital gains tax is applied when the disposal value is realised. Second, the disposal does not necessarily occur at the end of each period. It is hypothesised that, given a particular tax scenario, there will be an optimal shareholding period. Indeed, it will be demonstrated how the shareholding period may affect the share price. Third, the possibility of taxing only real gains will be introduced. This is consistent with tax law in the UK, the Republic of Ireland and Australia. However, the modelling will easily allow for the exclusion of relief for the indexation of inflation, so that it can readily be adapted for other countries.

The next section will deal with dividend growth under an infinite dividend series, assuming taxes are paid on realised gains at the end of each shareholding period. Further constraints will then be imposed, so that the model can be reconciled with O'Brien's (1991) annual horizon component discounting growth model, under personal taxes without indexation. The penultimate section will discuss the optimality conditions of the shareholding period for share price maximisation.

3. The model

Let us assume that P_T, the *ex-div* price of a share, which is acquired at time T, depends on the sum of the discounted value of the dividends after personal tax and the discounted value of the disposal after capital gains tax. The shareholding period is always n years. Under an imputation system, the dividend is grossed-up at the rate s_T, the gross equivalent of the imputed tax credit on D_T, the dividend at time T. The dividend is taxed at the marginal rate, m_T, so that after-personal tax dividend at time T is D_T^A, such that:

$$D_T^A \equiv D_T\,(1-t_d) \equiv D_T\,(1-m_T)/(1-s_T) \qquad (2)$$

Under a classical tax system, s_T would equal zero.

Suppose for capital gains tax purposes, there is an indexation allowance for inflation at the rate i_{T+1} from time T to T+1. After n years the indexed cost of a share acquired at time T grows to:

$$P_T\,(1+i_{T+1})(1+i_{T+2})\ldots(1+i_{T+n}) = P_T\Pi_{w=1}^{n}\,(1+i_{T+w}) \qquad (3)$$

Under UK legislation the indexation allowance is disallowed if there is a pre-indexed loss. This occurs when the original cost P_T exceeds the disposal value P_{T+n}. The capital gains tax liability at the rate $t_{g,T+n}$ at time T+n is applied to the difference between the disposal value and the original cost, which may be indexed for inflation. Assuming full indexation, the liability is therefore given by:

$$t_{g,T+n}\left\{P_{T+n} - P_T\Pi_{w=1}^{n}\,(1+i_{T+w})\right\}.$$

However, for more general cases the liability can be expressed as:

$$t_{g,T+n}\left\{P_{T+n} - P_T\lambda_{T+n}\Pi_{w=1}^{n}\,(1+i_{T+w})\right\}.$$

the value of λ_{T+n} depending on the tax position, which will now be explained.

Case 1

$$\lambda_{T+n} = 1, \text{ if:} \qquad (4)$$

$$P_T\Pi_{w=1}^{n}\,(1+i_{T+w}) \leq P_{T+n} \qquad (5)$$

i.e., the full indexation allowance is given, if there is no post-indexed loss.

Case 2

$$\lambda_{T+n} = P_{T+n} / \left\{ P_T \Pi_{w=1}^{n} \, (1 + i_{T+w}) \right\} \text{ if:} \tag{6}$$

$$P_T < P_{T+n} < P_T \Pi_{w=1}^{n} \, (1 + i_{T+w}) \tag{7}$$

i.e., the indexation allowance is restricted until there is a nil liability, if there is both a pre-indexed gain and a post-indexed loss.

Case 3

$$\lambda_{T+n} = 1/\Pi_{w=1}^{n} \, (1 + i_{T+w}) \text{ if:} \tag{8}$$

$$P_T \geq P_{T+n} \tag{9}$$

i.e., the indexation allowance is disallowed if there is a pre-indexed loss.

At time *T+n*, the allowable indexed cost per unit of outlay will have a value which, when discounted back to time *T*, is given by λ^A_{T+n}, such that:

$$\lambda^A_{T+n} = \lambda_{T+n} \Pi_{w=1}^{n} (1 + i_{T+w}) / \Pi_{w=1}^{n} (1 + R_{T+w}) \tag{10}$$

where R_{T-w} is the one period discount rate for the period ending at time *T+w* appropriate to the risk class of the capital gains tax relief on the indexed gain, which primarily reflects the inflation risk.

During the period from time $T+w-1$ to *T+w* the dividends are discounted at the one-period rate k_{T+w} and the disposal value after capital gains tax on the disposal (ignoring indexation which is treated separately) is discounted during this period at the rate q_{T+w} $(w = 1,\ldots,n)$.

The *ex-div* share price at time *T* is given by the discounted dividends up to and including those at time *T+n*, plus the discounted disposal proceeds, after deducting the capital gains tax rate applied to the disposal proceeds, plus the discounted value of the savings from capital gains tax relief on the original cost, which may be indexed:

$$\begin{aligned} P_T = {} & \Sigma_{j=1}^{n} \left\{ D^A_{T+j} / \Pi_{w=1}^{j} (1 + k_{T+w}) \right\} \\ & + \{ P_{T+n} - t_{g,T+n} \, P_{T+n} \} / \Pi_{w=1}^{n} \, (1 + q_{T+w}) \\ & + t_{g,T+n} P_T \lambda^A_{T+n} \end{aligned} \tag{11}$$

A special case of the model is when the indexation allowance is given in full ($\lambda_{T+n} = 1$) and the inflation rate is constant ($i_{T+w} = i$). Hence the inflation rate would be risk-free, so its discount rate R_{T+w} is the risk-free rate *r*. Hence, from equation (10):

$$\lambda^A_{T+n} = (1 + i)^n / (1 + r)^n \tag{12}$$

Assume further that the capital gains tax rate is constant ($t_{g,T+n} = t_g$) and that the dividends and disposal values are discounted at the same rate ($k_{T+w} = q_{T+w} = k$).

Rewriting

$$t_g (1 + i)^n / (1 + r)^n \equiv t_g^A \tag{13}$$

to represent the capital gains tax rate after full indexation; and incorporating dividend growth at the rate of *g*, such that:

$$D^A_{T+j} \equiv D^A_T (1 + g)^j \tag{14}$$

then

$$\begin{aligned} P_T = {} & \Sigma_{j=1}^{n} \left\{ D^A_T (1 + g)^j \right\} / (1 + k)^j \\ & + \{ P_{T+n} - t_g P_{T+n} \} / (1 + k)^n + t_g^A P_T \end{aligned} \tag{15}$$

It follows (see Appendix A) that:

$$P_T = u/v \tag{16}$$

$$\text{where } u = \left(\frac{D_{T+1}}{k - g} \right) \left(\frac{1 - m}{1 - s} \right) \left[1 - \left(\frac{1 + g}{1 + k} \right)^n \right], \tag{17}$$

$$\text{and } v = 1 - t_g \left(\frac{1 + i}{1 + r} \right)^n - (1 - t_g) \left(\frac{1 + g}{1 + k} \right)^n \tag{18}$$

Equations 16–18 reveal that the *ex-div* share price is found first by taking the pre-tax dividend next year and dividing by the difference between the after-tax risky rate *k* and the growth rate *g*. Second, this is grossed up for the shareholder tax credit and then taxed at the marginal income tax rate. Third, this is multiplied by one minus the present value of the accumulated sum of £1 compounded at the dividend growth rate for the shareholding period. Fourth, the result is then grossed-up for capital gains tax effects. The grossing-up procedure involves taking the capital gains tax rate, indexed for the shareholding period and discounted at the risk-free rate, and the result of one minus the capital gains tax rate, when compounded at the dividend growth rate for the shareholding period and discounted back at the risky rate.

It is important to see how this relates to O'Brien's (1991) annual horizon component discounting constant growth model, under personal taxes without indexation. To reconcile the two, assume the time is set to zero, the shareholding period is one year ($n = 1$), the indexation allowance is zero (i.e., treat inflation as zero: $i = 0$) and set $(1 - t_d) \equiv (1 - m)/(1 - s)$, to represent one minus the effective tax on dividends after imputation. The final result is that the current share price is given by:

$$P_0 = D_1 (1 - t_d) / \{ [k - t_g (k - r) / (1 + r)] - g (1 - t_g) \} \tag{19}$$

This is precisely O'Brien's (1991) result. The key assumption, however, is that the shareholding period is for one year only. Using the same composite discount rate k_a throughout the formula reduces further to:

$$P_0 = D_1(1-t_d)/[k_a - g(1-t_g)] \tag{20}$$

which represents the Haugen and Heins (1969) and Gordon and Gould (1978) formula.

4. The optimal holding period

One aspect of tax and investment planning is to determine whether or not to sell shares at particular points in time. The suggestion here is that the length of the shareholding period may influence the share's value. In practice, the retail prices index for capital gains tax purposes is a monthly calculation, and dividends can be split into the interim and final annual dividends, whereas the shareholding period can normally be measured continuously but only within certain times on most days. We shall make the bold assumption that all these variables are continuous, in order to make progress in providing insights into the factors at work.

The contribution to the marginal change in the share price based on a marginal change in the shareholding period is given by (see Appendix B):

$$\frac{\partial P_T}{\partial n} = t_g c v^{-2}[f x^n (y^n - 1) - b y^n (x^n - 1)] \tag{21}$$

where

$$c = [D_{T+1}/(k-g)](1-m)/(1-s), \tag{22}$$

$$f = \log_e[(1+r)/(1+i)], \tag{23}$$

$$x = (1+i)/(1+r), \tag{24}$$

$$y = (1+g)/(1+k), \text{ and} \tag{25}$$

$$b = \log_e[(1+k)/(1+g)]. \tag{26}$$

The shareholding period is irrelevant when (see Appendix B):

$$(1+k)/(1+g) = (1+r)/(1+i) \tag{27}$$

By deducting one from each side of this equation it follows, more easily, that the required condition is that the after-tax risky rate, discounted at the growth rate, equals the after-tax riskless rate, deflated at the general rate of inflation. Substitution in Equations 16–18 reveals that the share price is given by:

$$P_T = \frac{D_{T+1}}{k-g}\left(\frac{1-m}{1-s}\right) = \frac{D_{T+1}(1-t_d)}{k-g} \tag{28}$$

Since the capital gains tax rate does not appear, it is a condition for an irrelevant capital gains tax rate to the value of the share. Note that the shareholding period is irrelevant, since n does not appear in Equation 28.

But is not an irrelevant shareholding period a requirement for market equilibrium? For a market to exist there needs to be different preferences of investors, otherwise there would be no buying and selling of shares. The model represents what value a share should have, given representative tax rates. Clearly, the UK market comprises investors who pay taxes at different rates. For example, financial institutions may place different intrinsic values on shares than would private individuals. If a share is not at present held by an institution, but may become attractive through time, as institutions expand their holdings, then the future value of the share, P_{T-n}, may be higher under this assumption than would be predicted on the basis of homogeneous tax rates, i.e., the same as those of the present personal shareholders. Using the basic Equation 15, a different value of P_T may follow compared with the equivalent value with tax homogeneity. Also, there may be longer-term dynamic effects, not captured here. Opportunities for buying and selling shares can arise as different investors find their marginal tax rates changing through personal financial circumstances. But even if each shareholder has the same tax rate, there may still be different expectations of future performance. Different perceptions of future values, P_{T+n}, or even of inflation rates, can create a market for the buying and selling of shares. But given heterogeneous expectations, even if expected shareholding periods were different, the current share price could still be in equilibrium.

Now let us separate market pressures from fiscal effects. Let us assume an initial 'equilibrium' position in which the after-tax risky rate, discounted at the growth rate, equals the after-tax riskless rate, deflated at the general inflation rate. When there is an unanticipated fall in the rate of interest on treasury bills, short-term market forces would suggest that shares would generally be expected to rise in price so that there is a market pressure to buy shares in the short-term. But what are the fiscal effects predicted by the model? If inflation is held constant, the model would suggest that because the after-tax risky rate, discounted at the growth rate, temporarily exceeds the after-tax riskless rate, deflated at the general rate of inflation, then there is a fiscal pressure to sell shares in the short-run. The converse would apply in the case of an interest rate increase. Thus, the market and fiscal pressures work in opposite directions. This style of tax system may therefore provide a degree of stability in financial markets.

But since price adjustments can occur so rapidly in financial markets, it is possible that in practice investment advisers are swayed more by the market than by the tax system. Tax planning probably tends to concentrate less on the short-term, and so the fiscal damping effect may be weakened. Nevertheless, although the market pressures may dominate in the short-run, in the medium term the tax consequences are likely to be of some importance.

When the after-tax risky rate, discounted at the growth rate, is less than the after-tax riskless rate, deflated at the general inflation rate, we now know that the fiscal effect is that increasing the shareholding period increases the share price. Assuming also that the after-tax riskless rate exceeds the inflation rate, then the limiting value of the share is also identical to that shown by Equation 28. A fundamental difference, however, is that the tax system now motivates the investor to hold the share indefinitely. A shorter planned shareholding period would imply a lower share price at time P_T. For example, let us assume that the dividend is 10p, the after-tax risky rate is 7%, the growth rate 5%, the marginal income tax rate 40%, the shareholder tax credit 20%, the capital gains tax rate 40%, the inflation rate 3% and the after-tax riskless rate 6%. The share price is given by (substituting into Equations 16–18) 311p based on a shareholding period of one year, whereas the optimal value for an infinite holding period is 375p.

Conversely, when the after-tax risky rate discounted at the growth rate exceeds the after-tax riskless rate deflated at the general inflation rate, increasing the shareholding period decreases the share price. Under the specified model the share price is now optimised when the share is held for one period only. The *ex-div* share price at time T is now given by:

$$P_T = D_{T+1}[(1-m)/(1-s)]/\{k - t_g[(1+k)(1+i)/(1+r)-1] - g(1-t_g)\} \qquad (29)$$

For example, using the same parameters as before, except that the after-tax risky rate is now 10%, holding the share for one period results in a current share price of 177p, compared with 150p assuming an indefinite holding period.

Finally, when the capital gains tax rate is zero, the share price is given by Equation 28. Although this would be predicted in O'Brien's model (for $t_g = 0$), he assumed a one-year shareholding period, whereas the length of the shareholding period is irrelevant, since its value in this model was arbitrary.

5. Conclusions

A number of authors have considered a share's intrinsic value on the assumption that capital gains taxes are based on retentions or accrued gains, and/or that shares are held for one year. Such assumptions have even been applied to an infinite dividend series. In this paper, capital gains taxes are applied only when the disposal value is realised. Second, disposal takes place at an optimal point in time, the conditions for which are investigated. Third, to be consistent with UK, Irish and Australian tax law, only real gains are normally taxed, although the model can be amended to eliminate this final restriction.

A share valuation model was developed for an infinite dividend series, and the share price was expressed in terms of: the following year's dividend, the after-tax risky rate, the growth rate in dividends, the marginal income tax rate, the shareholder tax credit, the capital gains tax rate, the inflation rate, the after-tax riskless rate and the length of the shareholding period. The requirements for the holding period, which optimised the share's value, were found.

When the capital gains tax rate is zero, the length of the holding period is irrelevant. An irrelevant holding period also exists when (i) the after-tax risky rate discounted at the growth rate equals (ii) the after-tax riskless rate deflated at the general rate of inflation. When (i) is less than (ii), the investor is motivated to hold the share indefinitely, although the optimal share price is not a function of the capital gains tax rate. Conversely, when (i) exceeds (ii), increasing the shareholding period decreases the share price, so the model predicts a one-year holding period, in which case inflation and the income and capital gains tax rates affect the share price.

Appendix A

By deducting $t_g^A P_T$ from each side of Equation 15, and dividing the results throughout by $\left(1-t_g^A\right)$, the share price at P_T is:

$$P_T = \Sigma_{j=1}^{n}\left[D_T^A(1+g)^j/\left\{\left(1-t_g^A\right)(1+k)^j\right\}\right]$$

$$+ P_{T+n}(1-t_g)/\left\{\left(1-t_g^A\right)(1+k)^n\right\} \qquad (A1)$$

The disposal value at *T+n* is given by a similar expression, replacing *T* by *T+n* and *T+n* by *T+2n*. Also, at *T+2n*, *T* is replaced in (A1) by *T+2n*, and *T+n* by *T+3n*.
Hence:

$$
\begin{aligned}
P_T = {} & \{D_T^A(1+g)\left(1-t_g^A\right)^{-1}(1+k)^{-1} \\
& + D_T^A(1+g)^2\left(1-t_g^A\right)^{-1}(1+k)^{-2} + \ldots \\
& + D_T^A(1+g)^n\left(1-t_g^A\right)^{-1}(1+k)^{-n}\} \\
& + \{(1-t_g)\left(1-t_g^A\right)^{-2}(1+k)^{-(n+1)}D_T^A(1+g)^{n+1} \\
& + (1-t_g)\left(1-t_g^A\right)^{-2}(1+k)^{-(n+2)} \\
& \qquad D_T^A(1+g)^{n+2} + \ldots \\
& + (1-t_g)\left(1-t_g^A\right)^{-2}(1+k)^{-2n}D_T^A(1+g)^{2n}\} \\
& + \{(1-t_g)^2\left(1-t_g^A\right)^{-3}(1+k)^{-(2n+1)} \\
& \qquad D_T^A(1+g)^{2n+1} \\
& + (1-t_g)^2\left(1-t_g^A\right)^{-3}(1+k)^{-(2n+2)} \\
& \qquad D_T^A(1+g)^{2n+2} + \ldots \\
& + (1-t_g)^2\left(1-t_g^A\right)^{-3}(1+k)^{-3n}D_T^A(1+g)^{3n}\} \\
& + \{\ldots\} + \ldots
\end{aligned}
\tag{A2}
$$

By inspection, it can be seen that the series of the first terms within each curly bracket forms an infinite geometric progression, similarly for the series of second terms and so on. Hence the *ex-div* share price can be reformulated as follows:

$$
\begin{aligned}
P_T = {} & D_T^A(1+g)[1-t_g(1+i)^n/(1+r)^n]^{-1}(1+k)^{-1} \\
& /\{1-(1+g)^n(1-t_g)(1+k)^{-n} \\
& \qquad [1-t_g(1+i)^n/(1+r)^n]^{-1}\} \\
& + D_T^A(1+g)^2[1-t_g(1+i)^n/(1+r)^n]^{-1}(1+k)^{-2} \\
& /\{1-(1+g)^n(1-t_g)(1+k)^{-n} \\
& \qquad [1-t_g(1+i)^n/(1+r)^n]^{-1}\} \\
& + \ldots + D_T^A(1+g)^n[1-t_g(1+i)^n/ \\
& \qquad (1+r)^n]^{-1}(1+k)^{-n} \\
& /\{1-(1+g)^n(1-t_g)(1+k)^{-n} \\
& \qquad [1-t_g(1+i)^n/(1+r)^n]^{-1}\}
\end{aligned}
\tag{A3}
$$

Note that for convergence, the common ratio, in deriving (A3) from (A2), must be less than one and so:

$$(1+g)^n(1-t_g)<(1+k)^n\{1-t_g(1+i)^n/(1+r)^n\} \tag{A4}$$

For rational investment $k>g$ and $r>i$ and so (A4) would hold. But these n terms in (A3) now form a geometric progression, which is actually finite, so, by rewriting the post-tax dividend in full, the share price is:

$$P_T = u/v \tag{A5}$$

where

$$u = \left(\frac{D_{T+1}}{k-g}\right)\left(\frac{1-m}{1-s}\right)\left[1-\left(\frac{1+g}{1+k}\right)^n\right] \tag{A6}$$

and

$$v = 1-t_g\left(\frac{1+i}{1+r}\right)^n-(1-t_g)\left(\frac{1+g}{1+k}\right)^n \tag{A7}$$

Equations A5–A7 are written as Equations 16–18 in the main text.

Appendix B

Using also Equations A5 to A7, $P_T = u/v$ can be rewritten as:

$$P_T = c[1-y^n]/\{1-tx^n-(1-t)y^n\} \tag{B1}$$

dropping the subscript so that $t_g \equiv t$.

Strictly speaking, n is discrete, so $\partial P_T/\partial n$ does not exist. However, by treating n as if it were continuous, useful insights can be provided.

$$\frac{\partial P_T}{\partial n} = \left\{v\frac{\partial}{\partial n}[c(1-y^n)]-c(1-y^n)\frac{\partial v}{\partial n}\right\}/v^2 \tag{B2}$$

Now
$$
\begin{aligned}
\frac{\partial}{\partial n}[c(1-y^n)] &= -cy^n\log_e y \\
&= cy^n\log_e(1/y) = bcy^n
\end{aligned}
\tag{B3}
$$

and
$$
\begin{aligned}
\frac{\partial v}{dn} = \frac{\partial}{\partial n}[1-tx^n-(1-t)y^n] & \\
= -tx^n\log_e x-(1-t)y^n\log_e y & \\
= ftx^n+b(1-t)y^n &
\end{aligned}
\tag{B4}
$$

Therefore

$$
\begin{aligned}
\frac{\partial P_T}{\partial n} &= bcy^n v^{-1}-c(1-y^n)[ftx^n+b(1-t)y^n]v^{-2} \\
&= tcv^{-2}[fx^n(y^n-1)-by^n(x^n-1)]
\end{aligned}
\tag{B5}
$$

When $t=0$, and $v^{-2} \neq 0$, $\partial P_T/\partial n=0$, regardless of the value of n. But when the capital gains tax rate is positive, and $v^2>0$, then $\partial P_T/\partial n=0$ when:

$$fx^n(y^n-1)=by^n(x^n-1) \tag{B6}$$

But

$$f=-\log_e x, \tag{B7}$$

and

$$b=-\log_e y, \tag{B8}$$

therefore $\partial P_T/\partial n=0$, when:

$$\left(\frac{y^n-1}{x^n-1}\right)=\left(\frac{y}{x}\right)^n\left(\frac{\log_e y}{\log_e x}\right) \tag{B9}$$

Thus when $y = x$, $\partial P_T/\partial n = 0$, regardless of the value of n. This occurs (inverting both y and x and substituting their identity values) when:

$$(1+k)/(1+g)=(1+r)/(1+i) \tag{B10}$$

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The Relationship Between Assessments of Internal Control Strength and Error Occurrence, Impact and Cause

Arnold Wright and Sally Wright*

Abstract—Planning judgments concerning the nature, extent and timing of evidence are critical to an audit's effectiveness and efficiency. The auditing literature suggests that knowledge of the strength of a client's internal controls in various cycles is an important consideration in such judgments, since the controls' strength is expected to affect the likelihood and nature of financial statement errors. This study examines the occurrence, financial impact and cause of detected misstatements as related to the assessed strength of internal controls. Data on detected errors were gathered from a random, cross-sectional sample of 186 audit agreements. Auditors reported detailed information on 368 audit adjustments, representing 731 misstatements to individual accounts. The results indicated that as assessed internal controls weakened, the frequency of adjustments increased and adjustments were more likely to have an effect on income. However, error magnitude did not differ across control strength settings. Errors were more likely to reflect understatement of assets and liabilities when controls deteriorated, while when controls were strong, assets and liabilities were more frequently overstated. Finally, the causes of adjustments reflect a greater frequency of 'routine' errors as controls deteriorate, although cut-off errors were relatively common across all control settings. These results suggest that different audit strategies are appropriate in response to variations in controls.

1. Introduction

Planning judgments regarding the nature, extent and timing of procedures can significantly influence an audit engagement's effectiveness and efficiency. These judgments essentially represent the auditor's strategy for obtaining the appropriate evidence needed to express an overall opinion on the client's financial statements. It is well recognised in the professional literature (e.g., American Institute of Certified Public Accountants, 1983, 1988) that programme plans should be responsive to the likely risks of errors at both the macro (engagement) and micro (account, cycle and assertion) levels.

Previous auditing research has provided a significant amount of archival evidence on detection and inherent risks, as reflected by error patterns across accounts, error causes and procedures signalling the presence of misstatements (e.g., Wright and Ashton, 1989; Kreutzfeldt and Wallace, 1986; Ham et al., 1985; Hylas and Ashton, 1982). However, considerably less attention has been paid to the impact of control risk on error occurrence. The importance of client internal controls in audit planning is well accepted, perhaps best demonstrated by Statement on Auditing Standard No. 55, *Consideration of the Internal Control Structure in a Financial Statement Audit* (AICPA, 1988), which requires an understanding of the internal control structure on all audits. Internal controls are expected to affect the financial statements' reliability and underlying accounting records, which would seem to profoundly affect the incidence and nature of errors present.

To enhance our understanding of the relationship between client control risk assessments and accounting errors, the present study examines archival data from a large, cross-sectional sample of audit engagements regarding the nature (frequency, size, direction and income effect) of detected errors across control strength settings, as well as the association between control assessments and client size and error cause. These findings are expected to provide important information for auditors in considering an appropriate audit strategy to pursue. For example, if a greater incidence of understatement errors are present when controls are weak than when they are strong, greater focus may be placed on audit tests for completeness in weaker control settings. Finally, control strength would seem to be related to client size, with larger clients having stronger controls. Previous studies have examined many of these issues, but in a piecemeal fashion, and have often utilised restricted samples (e.g., selected accounts, a single industry). Further, these studies predominantly focus on error occurrence, while financial impact and error cause are also important in programme planning judgments, given the auditor's asymmetrical loss function and the detection capabilities of various audit tests. That is, auditors are especially concerned with misstatements of income, and many tests are designed to signal specific types of errors (e.g., understatement). These limitations in previous studies restrict our overall understanding of the relationship between internal control strength and error occurrence, impact and cause.

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The remainder of the paper is divided into five sections. The next section contains a review of the prior research findings and identifies the research questions examined. The method of the study is then described, followed by presentation of the results. The final sections are devoted to an identification of potential limitations of the research, and a discussion of the key findings and their implications for practice and future research.

2. Prior research and research questions

As discussed, a number of previous studies examine the nature of detected errors in accounting populations and how such errors are identified (e.g., Ham et al., 1985; Hylas and Ashton, 1982; Johnson et al., 1981). For example, relatively large numbers of errors are typically found in accounts receivable, accounts payable, cost of goods sold and inventory, with a greater tendency towards overstatement errors in accounts receivable, understatement errors in accounts payable, and errors about evenly divided between understatement and overstatement in inventory and cost of goods sold. Although such data are useful in providing a model of error presence (inherent risks) by account and the diagnosticity of various audit tests (detection risk), the effect of the strength of internal controls was not considered.

More recent studies have begun to explicitly consider the usefulness of control risk assessments in audit planning. Table 1 provides a summary of this research. Unexpectedly, the findings of three early studies (Willingham and Wright, 1985; Fess, 1984; and Johnson, 1987a) indicated no relationship between auditor assessments of internal controls and the incidence of detected errors. However, these studies focused on only one or two account areas (inventory and/or accounts receivable) and/or a single industry.

In an examination of errors across all accounts, Wallace and Kreutzfeldt (1990) and Kreutzfeldt and Wallace (1986) found the assessed strength of controls to be related to error occurrence, with the frequency of errors increasing as controls deteriorated. Johnson (1987b) also reported a negative association between clerical errors of inventory valuation and the strength of specific inventory pricing controls. Johnson (1988) examined the ability of a discriminant model to identify material errors, given assessments of the strength of specific internal control assertions. The results revealed that assessments of detailed controls significantly helped to predict the likelihood of 'routine' types of errors (cut-off, omission and classification). Wright and Ashton (1989) found that detection of errors was related to control strength, with internal evidence signalling a greater proportion of errors as assessed control strength increased, while Icerman and Hillison (1990) reported a greater incidence, variance and magnitude of errors when controls were weak than when they were strong.

Waller (1993) examined data drawn from actual working papers regarding the incidence of errors and risk assessments (inherent and control risks) at the assertion level. The findings indicate that inherent and control risk assessments are independent, although control risk is assessed at the maximum level in the majority of cases, most likely for efficiency reasons. The rate of misstatements, as expected, varied by assertion, and auditors' accuracy of assessing the rate of errors (inherent risk) by assertion was low. However, inherent and control risk assessments varied little over the assertions, suggesting the use of a 'most important' assertion heuristic. That is, an assessment is first made of the risk of a material misstatement for the assertion that is most likely to contain an error for a given account from an auditor's experience and training, e.g., accounts payable-completeness. Then risk assessments for other assertions are done in a mechanical, corresponding fashion, resulting in a significant halo effect. Given strong evidence of this heuristic, Waller questions the usefulness of requiring separate risk assessments for each assertion.

Finally, Wallace and Kreutzfeldt (1995) use regression analysis to examine the relationship between error frequency for an engagement and five categories of client factors representing both inherent and control risks. They report evidence that supports the notion that a planning model reflecting risk assessments from all categories is significantly related to error incidence. Of particular relevance to the current study, as expected, error incidence was significantly reduced as the strength of detailed controls at the account and cycle levels increased.

In summary, previous research has generally documented the reduction in the occurrence of er-

Table 1
Summary of prior research

Study	*Focus*	*Consideration of controls*	*Engagements*	*Industries*	*Accounts*	*Error data*	*Audit firm(s)*	*Results re affect of controls*
Fess (1984)	Error incidence and strength of controls	Explicit (control objective)	n=44 selected	Electronics	Inventory	All errors	One Big Eight firm	No relationship between control assessments and error incidence
Ham et al. (1985)	Direction, magnitude distribution and cause of errors	Implied	n=20 selected (five years' data)	Three industries	Five accounts	All errors	Price Waterhouse	Client differences in error rates within industries suggest an impact of controls
Willingham and Wright (1985)	Relationship between errors and control assessments	Explicit	n=82 random	Manufacturing	Accounts receivable, inventory	All errors	KPMG Peat Marwick	No relationship present between error magnitude and control assessments
Kreutzfeldt and Wallace (1986)	Error incidence, magnitude, cause and detection as related to environmental factors	Control environment	n=260 random	Three industries	Cross-section	Errors > minimum limit affecting income	Arthur Andersen	Error incidence and magnitude less as upper level (control environment) controls stronger
Johnson (1987a)	Detected error size as related to control and inherent risks	Explicit (control objectives)	n=55 selected (two years' data)	Manufacturing	Cross-section	All errors that could individually or in aggregate be material	Six firms	No relationship between error size/direction and control assessments
Johnson (1987b)	Relationship between error size and inherent/control risks	Explicit (control objectives)	n=129 random and selected	Fabricated metal products	Inventory	All errors	Five firms	Size and variation of clerical errors increased as pricing controls deteriotated
Johnson (1988)	Relationship between error incidence and inherent/control risk	Explicit (control objective)	n=64 selected (two years' data)	Manufacturing	Cross-section	All errors	Six firms	More routine errors present when controls weaker

Table 1
Summary of prior research (continued)

Study	*Focus*	*Consideration of controls*	*Engagements*	*Industries*	*Accounts*	*Error data*	*Audit firm(s)*	*Results re affect of controls*
Wright and Ashton (1989)	Error detection as related to control reliance	Explicit	n = 186 random	Cross-section	Cross-section	Four largest; ≥ 20% of materiality	KPMG Peat Marwick	Internal evidence detected more errors as controls weakened
Wallace and Kreutzfeldt (1990)	Relationship between control assessments and error rate/size	Explicit (all elements of control structure)	n = 260 random	Three industries	Cross-section	Errors > minimum limit affecting income	Arthur Andersen	Assessments of controls at cycle level associated with errors at aggregate and account level
Icerman and Hillison (1990)	Error incidence/ size as related to control strength	Explicit	n = 49 (three years)	Manufacturing (medium size)	Five accounts	All errors	Seven firms	Error incidence and magnitude greater as controls deteriorate
Waller (1993)	Inherent and control risk assessments at the assertion level	Explicit	n = 215 random	Cross-section	Accounts receivable, inventory, accounts payable	Errors > tolerable error	KPMG Peat Marwick	Control risk assessments vary little across assertions
Wallace & Kreutzfeldt (1995)	Relationship between inherent and control risk assessments and engagement error frequency	Explicit	n = 260 random	Three industries	Cross-section	Errors > minimum limit affecting income	Arthur Andersen	Error incidence negatively associated with strength of management level and detailed (cycle/account) controls

rors as internal controls are assessed as stronger. However, there are very limited, ad hoc findings regarding the nature (direction, account and income effect) and cause of errors across different control settings. To examine the relationship between internal control assessments and misstatements, it is important to take a comprehensive approach in considering these factors. Accordingly, this study examines the following research questions:

Q1 Does the incidence of detected errors vary with assessed control strength?

Q2 Does the financial impact (direction, size, and income effect) of detected errors vary with assessed control strength?

Q3 What is the impact of client size on the assessed strength of controls?

Q4 Does the cause of detected errors differ across control risk settings?

The method utilised to examine these questions is described in the following section.

3. Method

3.1. Test Instrument

The data were gathered from a sample of KPMG Peat Marwick (PM) engagements. The objective of the research was to examine detailed information on detected misstatements across a broad spectrum of audit engagements. The information sought included the nature of the error, cause and assessment of internal control strength.[1] To capture this data, an instrument[2] was devised to guide auditors in abstracting the desired information from the working papers of an engagement.

To keep the time commitment to a reasonable level and, thus, enhance the response rate, the following reporting criteria were employed:

1. adjustments equal to or greater than 20% of planning materiality;
2. maximum of four largest adjustments;
3. only 'non-bookkeeping' adjustments.

The overriding objective was to obtain a representative sample that captures larger misstatements of significant risk to the auditor.[3]

Planning materiality, referred to as 'gauge' at Peat Marwick, is computed on the greater of total assets or revenue (see Elliott (1983) for a discussion of gauge). Thus, planning materiality is normally based on assets for financial institutions and revenues for other clients, suggesting either a balance sheet or income statement orientation contingent on the client's industry. Since gauge was developed from a study of actual engagements, it reflects the magnitude that auditors considered sufficiently large to potentially affect user decisions. Gauge is employed here as a means to consider the relative size of a detected misstatement in comparison to the firm's guidelines as to materiality for the specific client setting.

The same error-cause categories were employed by Hylas and Ashton (1982). These categories were developed from unstructured auditor responses and, thus, are familiar to auditors in practice.[4]

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[1] Data were also obtained on the means of error detection (e.g., analytical procedures, client inquiry), which is outside the scope of this research. The findings on this issue are reported in [Wright and Ashton, 1989].

[2] A copy of the instrument is available on request from the authors.

[3] Discussions with audit managers and partners indicated that there would be few engagements with more than four detected adjustments exceeding the size threshold of 20% of materiality. Indirect support for this view was provided by the number of total detected adjustments. Irrespective of the size criterion, respondents were also asked to indicate the total number of adjustments identified on the engagement.

For those engagements reporting fewer than four significant misstatements, the data, thus, reflect complete information on all detected adjustments greater than or equal to 20% of planning materiality. Where four adjustments are reported, however, there is the possibility of incomplete data relating to other additional significant adjustments.

The number of total adjustments ranged from 0 to 67 with a mean of 13.9. A detailed breakdown is as follows:

Number of significant adjustments	*Significant adjustments reported*	*Total adjustments*	*Significant adjustments/ total adjustments*
1-3	124	828	15.0%
4	244	1,596	15.3%
Total	368	2,424	15.2%

'Significant' adjustments are defined as those equal to or greater than 20% of planning materiality.

Thus, it appears that even though a large number of adjustments are found on engagements, relatively few (about 15%) represent larger misstatements. Further, these data also suggest that the 244 adjustments reported for those engagements with at least four larger misstatements were a reasonably complete reflection of the significant adjustments detected.

Additionally, by restricting the information gathered to four misstatements, the power of the statistical tests was reduced and, conceptually, as controls become weaker, more errors are expected to be present (potentially reaching a maximum of 67 adjustments as reported above).

[4] Adjustment cause categories and descriptions provided in the test instrument were as follows:

- *Personnel problems.* Turnover, new/inexperienced employees, carelessness, time pressures, incompetence.
- *Insufficient accounting knowledge.* Lack of awareness of generally accepted accounting principles or client's accounting

The instrument was distributed to engagement partners near or just after the end of the most recent audit. The instructions stipulated that the engagement manager was to complete the instrument with assistance from the staff assigned to the engagement for detailed information on specific errors. The partner was then asked to review the completed instrument for accuracy and completeness and return it by mail to the executive office of the participating CPA firm.

A concern in the study's design was a potential 'self-fulfilling prophecy' problem. That is, if few errors were detected, the auditor might conclude that controls, therefore, must have been strong, or vice versa if several errors were encountered. To minimise this problem, the instrument focused on gathering factual data taken from the actual working papers, such as errors found (accounts, amount) and control reliance (i.e. reduction of control risk) prior to programme planning. However, since a final determination of control reliance naturally occurs after tests of controls and some dual purpose tests are conducted, it is possible that the reliance decision reflected, in part, expected errors.

3.2. The Sample

The study is based on a US random sample of Peat Marwick engagements conducted in 1984–85, representing six broad industry categories.[5] A request by the executive office for participation in the project resulted in 186 responses, representing a response rate of 45%. The mean client size was \$167m in revenues and \$469m in assets, with ranges from \$197,000 to \$3.5bn and \$180,000 to \$12.8bn, respectively.[6] The mean planning materiality was \$661,000.

3.3. Internal Control Strength

As discussed earlier, the focus of this study is on the relationship between the assessed account-specific internal controls and the occurrence, direction, impact and cause of misstatements.[7] For each reported audit adjustment, auditors were asked to indicate the assessment of internal controls for the account areas surrounding the adjustment, as noted in the working papers after evaluation and tests of control. As a result of double-entry accounting, an audit adjustment entails 'errors' in two or more accounts. Since internal controls could vary between these accounts, auditors specified the strength of controls for each account separately.

Auditors' responses regarding the strength of internal controls were measured on a four-point scale: strong controls, moderate controls, weak controls, and controls 'not relied on'. The last scale value is utilised when the assessed level of control risk is set at the maximum level. This scale was the one used by the firm in practice and, thus, is a familiar response mode for the participating auditors. Further, the information could be taken directly from the working papers, reflecting the audit's actual sequential decision process rather than an ex post assessment of controls, given the errors detected.

One difficulty with the scale used is the category of 'controls not relied on'. This assessment may be made either when controls are very weak *or* when it appears that conducting a detailed review and tests of controls would not be as cost effective as extending substantive tests and assessing control risk at the maximum level.[8] Given the competitive

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policies.
- *Cut-off or accrual.* N/A (considered self-explanatory).
- *Judgment.* Poor or unreasonable estimates based on inadequate information, e.g., uncollectible accounts.
- *Mechanical.* Improper posting, footing, coding, calculations.
- *Inadequate control, follow-up or review procedures.* Non-compliance with internal controls, failure to follow-up reconciliation differences, failure to review account collectibility, etc.
- *Other.* Specified by respondent.

[5] The industry representation of the sample was as follows:

Number of engagements:	
Manufacturing	38
Merchandising	18
Banking	36
Savings and loan	14
Insurance	46
Natural resources	19
Other	15
Total	186

[6] The sample reflects a wide range of firms in terms of size that are on average smaller than New York and American Stock Exchange companies—approximately \$2bn in total assets (Smith and Pourciau, 1988)—but does include some large clients.

[7] Since the focus of this study is on the effects of internal controls, data were not gathered on assessments of inherent risk. That is, *ceteris paribus*, can evaluations of internal controls assist the auditor in more efficient and/or effective audit planning? Conceptually, inherent risks can confound the analysis, since such risks can affect one of the factors studied here—e.g., error cause. A large and diverse sample was selected in this study to randomise the potential effects of inherent risk.

[8] An alternative approach would have been to request auditors to evaluate the strength of the controls *irrespective* of the choice of degree of reliance on the controls. In this manner, an unambiguous assessment of control strength would conceptually be obtained. However, as discussed, in this research there was particular concern of a potential ex post 'self-fulfilling prophecy' problem, i.e., an individual reasoning that if errors were discovered, controls, therefore, must have been weak. In contrast, the control reliance decision used can be abstracted directly from the working papers, reflecting an ex ante evaluation of the controls.

Future research, however, is needed to corroborate the results here by utilising a more disaggregated measure of assessed control risk. Further, future studies may gather data on control assessments sequentially—before and after control testing. This earlier assessment may be less subject to the 'self-fulfilling' prophecy concern, discussed earlier, since the auditor would not have conducted any audit tests and, thus, would have no indications of errors present.

On the other hand, consideration should also be given to environment in public accounting, there may be a tendency to avoid conducting any tests of controls unless the controls are sufficiently strong such that there is a high likelihood that such tests will be cost justified (Mock and Wright, 1993). In this sample, the choice of not relying on controls was made for about two-thirds of the account areas in which errors were detected.[9] Thus, this internal control assessment is ambiguous as to the existing strength of controls.[10] However, Willingham and Wright (1985) found that the pattern of initial assessments and subsequent reliance suggests that internal controls generally are considered to be weaker when the controls are not relied on by auditors.

4. Findings

4.1 Error Occurrence and Impact as Related to Control Risk Assessments (Q1–2)

Table 2 presents the results of the account areas and direction of a total of 731 reported errors.[11] Chi-square tests were conducted to identify significant ($p \leq 0.10$) differences in the incidence of errors among accounts by control strength (for some accounts the low frequency of errors prohibited valid statistical analysis). There were proportionately more cash, accounts receivable and accounts payable errors when internal controls were judged strong, and more property and general and administrative expense errors when controls were considered weaker. This pattern of differences across control settings may reflect underlying incentives by management to design and implement effective controls for various areas of the business. For instance, general administrative expenses and capital expenditures (property) are often significant discretionary areas for management in establishing controls, perhaps accounting for the fact that more errors were detected in these areas as controls deteriorated. Validation of this explanation awaits future research. The frequency of inventory and cost of goods sold errors were relatively stable across assessed client control categories, which may explain why previous studies focusing on these accounts found no relationship between assessments of control strength and error incidence (Willingham and Wright, 1985; Fess, 1984).

As discussed earlier, an issue of great concern is the relationship between assessed control strength and incidence of errors. The auditing literature (e.g., SAS No. 31) (AICPA, 1980)) suggests that there should be fewer errors as controls become stronger. To examine this question, the number of reported adjustments on each engagement was regressed against assessed strength of controls. A strong relationship ($F = 137.2$; $p < 0.0001$; adjusted $R^2 = 0.80$) was found, and in the expected direction, with fewer adjustments present as the assessment of the control strength increased. These results corroborate those of Icerman and Hillison (1990) and Wallace and Kreutzfeldt (1990).[12]

As shown in Table 2, errors are primarily overstatements when controls are strong, but increasingly reflect a predominance of understatement errors (suggesting greater risk regarding the completeness assertion) as controls become weaker. A chi-square test ($\chi^2 = 8.77$) indicated a significant directional difference ($p = 0.03$) across the four control categories.

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excluding cases in which controls were not relied on. When no reliance occurs, auditors do not conduct control and dual purpose tests. Then, what is the basis for the auditor to accurately evaluate control strength?

[9] To gain additional insights regarding the reliance decision, error situations where controls were not relied on were compared to those in which some reliance occurred as to industry, financial and account variables. There was a significant industry effect present ($\chi^2 = 68.3$; $p = 0.0001$), with substantially less reliance for clients in the savings and loan and insurance industries.

No reliance situations reflected significantly smaller clients in terms of net income ($p = 0.05$), stockholders' equity ($p = 0.01$), and gauge ($p = 0.04$). Additionally, chi-square analyses revealed that the following accounts were significantly ($p < 0.05$) more likely to result in no reliance (reliance): accounts receivable; (cash); (accounts payable); and stockholders' equity.

[10] Given the large incidence of situations where controls were not relied on in this sample, and the ambiguity of this control assessment, statistical analyses were performed both on the aggregate sample of errors and also on the sample excluding cases in which there was no reliance on controls. The results were the same, except (Table 2) that there were no significant directional patterns (overstatement, understatement) present for liabilities across control settings when no reliance data were excluded. Since the findings are the same (with the one exception noted), only aggregate results are presented.

[11] Recall that each audit adjustment (entry) affects two or more accounts, and, thus, represents two or more 'errors'. A reconciliation of the number of detected errors and adjustments is as follows:

Adjustments reported	*Errors*
368 x 2 accounts affected	736
Adjustments affecting more than 2 accounts (15.2% x 368)	56
Total errors reported	792

However, information on the level of internal controls was not indicated for *61 errors*, resulting in a *final sample of 731*. The missing responses were further examined to determine if any apparent patterns were present, in either error incidence or cause—the focus of the research. Errors related to these responses were not concentrated in any particular account(s), but represented misstatements across all account categories. The distribution of error causes closely mirrored that of the aggregate sample. Finally, missing responses were from clients in all industries except savings and loan institutions. In sum, no overriding pattern was evident for these errors.

[12] Given the constraint of four reported adjustments on an engagement, the continuity of the dependent variable (error incidence) is in question. To test for a ceiling effect, the regression analysis was repeated with a reciprocal transformation of the dependent variable. The results again revealed a strong relationship between error incidence and control reliance in the expected direction ($F = 29.4$; $p < 0.0001$; adjusted $R^2 = 0.50$).

Table 2
Data on detected errors from sample engagements

	Strong controls	Direction			Moderate controls	Direction			Weak controls	Direction			Not relied on	Direction			
Accounts	*Freq(%)*	*Over-state*	*Under-state*	*Mean% gauge*	*Freq(%)*	*Over-state*	*Under-state*	*Mean% gauge*	*Freq(%)*	*Over-state*	*Under-state*	*Mean% gauge*	*Freq(%)*	*Over-state*	*Under-state*	*Mean% gauge*	χ^2
Cash	4(11)	4	0	206	5(3)	1	4	85					6(1)	1	5	209	15.8a
Marketable securities and other investments	2(5)	1	1	101	9(6)	3	6	200					26(5)	17	9	230	
Accounts receivable (net)	5(12)	2	3	184	25(15)	15	10	191	1(2)	1	0	82	37(8)	29	8	107	13.3a
Notes receivable													4(1)	2	2	151	
Inventory	4(11)	3	1	169	10(6)	3	7	76	6(15)	2	4	86	33(7)	14	19	78	
Prepaid expense and other current assets	1(2)	1	0	34	3(2)	1	2	174	2(5)	0	2	75	17(3)	5	12	203	
Long-term investments													3(1)	1	2	67	
Property, plant and equipment					4(3)	2	2	244	7(17)	1	6	127	22(4)	8	14	84	17.1a
Intangible assets	1(2)	0	1	6													
Deferred chrgs, and other non-current assets	1(2)	1	0	160	9(6)	2	7	84	1(2)	0	1	111	21(4)	7	14	148	
Accounts payable	10(24)	7	3	167	11(7)	5	6	226	3(7)	0	3	18	22(4)	9	13	52	25.7a
Accrued liabilities	2(5)	1	1	35	10(6)	2	8	51	1(2)	0	1	15	39(8)	12	27	272	
Income taxes payable													3(1)	0	3	58	
Other current liabilities					4(3)	2	2	20	4(9)	3	1	89	14(3)	4	10	130	7.2c
Notes payable and long-term debt									1(2)	0	1	300	5(1)	1	4	186	
Deferred taxes													3(1)	0	3	58	
Other long-term liabilities	1(2)	1	0	160	3(2)	1	2	53	1(2)	1	0	94	23(5)	7	16	74	
Stockholders' equity	1(2)	1	0	56									44(9)	24	20	80	20.6a
Revenue	3(7)	1	2	27	17(11)	6	11	79	1(2)	0	1	38	36(7)	23	13	98	
Cost of goods sold	4(11)	1	3	211	22(14)	11	11	91	4(9)	2	2	50	47(10)	21	26	110	7.4c
Selling expense					4(3)	0	4	78	1(2)	0	1	62	19(4)	9	10	213	
G and A expenses	1(2)	0	1	10	18(12)	9	9	103	9(22)	3	6	41	53(10)	21	32	117	7.4c
Other accounts	1(2)	1	0	7	1(1)	1	0	26	1(2)	0	1	56	15(3)	7	8	57	
Total errors	41	25	16	139	155	64	91	120	43	13	30	76	492	222	270	128	

Notes:
(1) Chi-square tests were conducted to examine the relative frequency of various types of errors across internal control environments.

For example, a contingency table for accounts receivable would be as follows:

	Control strength			
Detected errors	*Strong*	*Moderate*	*Weak*	*Not relied on*
Accounts receivable	5	25	1	37
Other accounts	36	130	42	455
Total	41	155	43	492

(2) Only significant results are shown
a ≤0.01
b ≤0.05
c ≤0.05

Table 3
Effect of adjustments on income

	Internal			*Average size*		*Average income effect*	
Effect	*Controls*	*Number*	*%*	*$(000s)*	*% of gauge*	*$(000s)*	*% of gauge*
	Strong						
Increase income		4	19.0%	$284.3	23.2%	284.3	23.2
Decrease income		5	23.8	208.2	135.6	205.8	132.6
No effect		12	57.2	3,534.7	169.8		
Total		21			133.7		84.0
	Moderate						
Increase income		19	28.4	504.1	92.4	496.4	77.0
Decrease income		26	38.8	475.6	108.7	441.7	99.0
No effect		22	32.8	836.2	143.9		
Total		67			115.6		89.7
	Weak						
Increase income		9	40.9	511.1	53.7	511.1	53.7
Decrease income		7	31.8	299.0	53.8	123.0	31.8
No effect		6	27.3	254.2	183.3		
Total		22			89.1		44.1
	Not relied on						
Increase income		64	27.1	366.8	92.2	282.5	77.8
Decrease income		111	47.0	372.9	159.3	293.3	172.1
No effect		61	25.9	2,144.4	169.6		
Total		236			143.8		137.6
	All adjustments						
Increase income		96	27.7	325.3	85.8	346.3	73.1
Decrease income		149	43.1	381.8	144.7	308.3	151.4
No effect		101	29.2	1,912.3	164.8		
Total		346			134.2		119.1

Note: The 'size' of the adjustment refers to the amount (% of gauge) of the total debits or credits. 'Income effect' is the impact on income. For example, consider the following hypothetical adjustment (gauge = 90):

Costs of goods sold	100	
Inventory	50	
Accounts payable		150

The 'size' is 150 (169% of gauge) and the income effect is 100 (111% of gauge).
The data reported reflect the mean size and income effect of adjustments categorised by control strength ($ and % of gauge).

To better understand error direction patterns, total errors were further disaggregated into four broad financial statement categories: assets, liabilities, revenues and expenses. (There were few misstatements of equity.) Chi-square tests revealed significant directional differences for assets ($\chi^2 = 7.82$; $p = 0.05$) and liabilities ($\chi^2 = 7.88$; $p = 0.049$) across control categories. Specifically, as the assessed controls deteriorated, assets and liabilities were more prone to understatement. When assessed controls are strong, assets and liabilities are more likely to be overstated. Table 2 presents the direction of errors by account across control settings. All accounts conform to the directional pattern noted, except for accounts receivable, which is more likely to be overstated for most control scenarios.

The size and income effect of audit adjustments are also of significant interest, given the auditor's asymmetrical loss function towards ensuring that larger errors and those affecting income are detected. Table 3 indicates[13] that adjustments are more likely to have an income effect as controls become weaker, suggesting greater audit exposure in these circumstances. A chi-square test revealed that this difference in effect on income is significant ($\chi^2 = 9.68$; $p = 0.02$).

The findings regarding the size of individual detected adjustments suggest that even when internal controls are strong, there are significant risks of material misstatements. In terms of planning materiality (gauge), when controls were assessed as strong, the average adjustment reducing income (greatest risk) was 132.6% of gauge, which was higher than all other control categories except not relied on (172.1%). Further, irrespective of income effect, the average size of an adjustment when controls were viewed as strong was higher (133.7% gauge) than under all other control situations except not relied on (143.8% gauge). A one-way ANOVA, however, did not reveal a significant difference ($p \leq 0.10$) in adjustment size across the control levels as to mean adjustment *size* (expressed as a percentage of gauge) in terms of all adjustments combined, income increasing adjustments, income decreasing adjustments, and reclassification entries.

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[13] The total number of detected errors (adjustments) in Tables 3–5 does not agree with Table 2 for two reasons. First, Table 2 focused on *errors*, while Table 3 presents data on *adjustments*. As noted, errors reflect a misstatement to an individual account, and adjustments reflect accounting entries inherently involving two or more accounts. Second, the tables examine different variables, and the number of *missing responses* differs across the variables.

4.2. Client Size (Q3)

The strength of internal controls is expected to be related to client size, measured as total assets here. Larger clients have the resources to develop stronger internal control systems and need better controls to monitor complex, voluminous operations. This expectation is confirmed in Table 4, where the results of a chi-square test indicate that there is a significant difference present in control strength as related to client size in the anticipated direction ($\chi^2 = 12.83$; $p = 0.046$).

4.3. Cause of Audit Adjustments (Q4)

Table 5 presents information on the cause of audit adjustments under different internal control settings. 'Routine' errors in this study fall into four areas: personnel problems, cut-off errors, mechanical errors and inadequate control or follow-up. These error causes reflect the normal, day-to-day operation of the accounting system and, thus, are presumed to be affected by the internal controls in place, which are designed to prevent and detect errors in transactions. In contrast, the 'non-routine' errors are outside of the usual transactions cycle such as errors in accounting estimates (judgments).

A chi-square test revealed a significant difference here ($\chi^2 = 13.51$; $p = 0.004$) in the incidence of routine versus non-routine errors between the control strength categories. As expected, the error cause results displayed a general tendency for a higher likelihood of routine errors as controls deteriorated from moderate to weak. However, the relatively high incidence of routine errors in strong control settings was unexpected and may be a result, in part, of the fact that the audit occurs after the end of the year, providing an opportunity to identify unrecorded transactions. This and other potential reasons for such a fnding are explored in the next section. There were, however, no significant differences in the incidence of routine as compared to non-routine *material errors* across control settings.

5. Potential limitations

In interpreting the findings, potential limitations of the study need to be considered. A methodological decision was made to limit responses to errors that equal or exceed 20% of audit gauge, and for a maximum of four adjustments. This choice was made in order to focus on larger errors, which are of the greatest concern to auditors, and to ensure the response time was reasonable. Therefore, the findings relate only to larger errors. Further, the

Table 4
Errors by client size and controls

		Internal controls				
Client size		*Strong*	*Moderate*	*Weak*	*Not relied on*	*Total*
Larger	(n=364)	7.7%	22.3	4.1	65.9	100%
Middle	(n=211)	4.3%	22.7	7.6	65.4	100%
Smaller	(n=156)	2.5%	16.7	7.7	73.1	100%
Total	731					

Findings: Control strength by client size
$\chi^2 = 12.83$; $p = 0.046$

Notes:

1. Client size: Larger— total assets >$50m
Middle— total assets between $10m-50m
Smaller— total assets <$10m
2. n = number of detected errors

Table 5
Cause of detected adjustments

Cause of adjustment	*Strong controls*			*Moderate controls*			*Weak controls*			*Not relied on*		
	Total *(n=20)* %	*Small* *(n=15)* %	*Mat.* *(n=5)* %	*Total* *(n=64)* %	*Small* *(n=37)* %	*Mat.* *(n=27)* %	*Total* *(n=19)* %	*Small* *(n=14)* %	*Mat.* *(n=5)* %	*Total* *(n=216)* %	*Small* *(n=157)* %	*Mat.* *(n=59)* %
Routine causes												
Personnel problems	0.0	0.0	0.0	9.4	13.5	3.7	10.5	7.1	20.0	6.0	7.0	3.4
Cut-off or accrual errors	25.0	20.0	40.0	26.5	21.6	33.3	47.4	50.0	40.0	13.0	13.4	11.9
Mechanical errors	40.0	40.0	40.0	6.2	5.4	7.4	15.8	21.6	0.0	12.0	10.8	15.3
Inadequate control, follow-up	10.0	13.3	0.0	12.5	8.1	18.5	0.0	0.0	0.0	14.4	13.4	16.9
Other	0.0	0.0	0.0	1.6	2.7	0.0	5.3	7.1	0.0	0.5	0.6	0.0
Total routine causes	75.0	73.3	80.0	56.2	51.3	62.9	79.9	85.8	60.0	45.9	45.2	47.5
Non-routine causes												
Insufficient accounting knowledge	20.0	26.7	0.0	21.9	13.5	33.4	10.5	7.1	20.0	33.3	31.9	37.3
Judgment errors	5.0	0.0	20.0	21.9	35.2	3.7	10.5	7.1	20.0	20.8	22.9	15.2
Total non-routine causes	25.0	26.7	20.0	43.8	48.7	37.1	21.0	14.2	40.0	54.1	54.8	52.5

Note: Small errors < gauge
Mat. (material) ≥ gauge

Findings: Q_3—Cause (routine vs non-routine) by control strength
$\chi^2 = 13.51$; $p = 0.004$ aggregate
$\chi^2 = 3.32$; $p = 0.32$ material adjustments

limitation of four reported adjustments for an engagement may have resulted in the omission of some errors that could affect the findings. As noted earlier, however, the sample appears to be a reasonably complete representation of larger detected errors.

Two other limitations are inherent to field studies of error incidence: the data is based on *detected errors*; and error detection may be affected by *audit intensity*. The focus is on detected errors as in previous studies on error incidence (e.g., Hylas and Ashton, 1982), due to the practical inability of identifying other undiscovered errors that may also be present. Thus, with the exception of litigation suits, there is generally no feedback information available regarding undetected errors. A second concern is the effect of audit intensity. When controls are considered weak, the auditor is expected to compensate by performing extensive substantive testing, potentially affecting error detection. However, since the focus of this study was an examination of the relationship between control risk assessments and error detection, the findings help further our understanding of the inferences that can be made from control risk assessments in planning the appropriate evidence strategy to pursue.

Given the potential incomplete population limitation of field studies, future research that is able to assess the relationship between controls and the incidence and/or detection of *all errors* present would be valuable. Approaches such as seeding errors or simulations seem promising in this regard.

Also, this study examined Peat Marwick engagements only, although the sample included a diverse client base. Firms may vary on the extent to which they perceive that reliance on controls is appropriate. For instance, empirical data confirm that PM's audit approach tends toward a substantive approach with frequent incidences of no reliance on controls (Waller, 1993), while other firms may have a strategy of greater reliance on controls.[14] Thus, the external validity of the results here would be enhanced with corroborating data from other auditing firms' clients.

6. Discussion

The findings suggest that the assessed strength of account-specific internal controls appears to be related to the occurrence, impact and direction of detected errors. When controls were assessed as weaker, errors were more likely to have an effect on reported earnings, suggesting greater audit exposure. Errors were also more likely to reflect understatement of assets and liabilities when controls deteriorated, while when controls were strong, assets and liabilities were more frequently overstated. Interestingly, the directional patterns found point out the apparent predominant unintentional nature of errors. That is, if misstatements were intentional, one would normally expect that *ceteris paribus* (setting aside anomalies like the windfall profits tax era and anti-trust/regulatory types of considerations) management would wish to overstate assets and understate liabilities to enhance the financial condition presented for the firm. Yet, as noted, the error patterns were found to be in a single direction for both assets and liabilities, contingent on assessed control strength.

The directional patterns found may have important implications for the appropriate focus of audit tests under different internal control situations, since procedures should be tailored to risks present. The apparent directional bias toward understatement errors in weaker control settings implies that auditors may consider a greater focus on tests directed toward omissions in the accounting records in such situations. Kreutzfeldt and Wallace (1986) also found omission errors to be prevalent. In a more general sense, there has been little research on which audit procedures are more effective in detecting understatement errors—a troublesome and difficult problem in auditing.

The existence of several material errors in strong control situations suggests that significant exposure nonetheless exists even in these settings. However, this study focused on control risk assessments at the account level. The findings, thus, provide support for the consideration of all elements of the control structure as directed by SAS No. 55 (AICPA, 1988), as well as inherent risks. Consideration of control environment risk factors may serve to further mitigate such risk and enable auditors to avoid conducting costly audit procedures. For example, a management with strong knowledge of accounting and a willingness to consult with the auditors may substantially reduce the frequency of errors. The results of studies in this area (Wallace and Kreutzfeldt, 1995; Wallace and Kreutzfeldt, 1991; Houghton and Fogarty, 1991; Icerman and Hillison, 1990; Wallace and Kreutzfeldt, 1990; Kreutzfeldt and Wallace, 1986; Johnson, 1988) suggest a relationship between error incidence and a number of inherent risk and control environmental factors.

The results on the causes of errors under varying internal controls settings were surprising. While, as expected, there were relatively fewer routine errors as control strength increased, some mechanical and cut-off errors were nonetheless present in strong and moderate control situations. It would seem that there is an exposure to such errors even in stronger control settings. Further research is needed to substantiate the findings here and to explore why such apparent 'routine' errors appear to persist. For example, mechanical errors for companies with strong controls may relate to areas of complex processing or complex accounting methods, such as inventory pricing or accounting estimates.

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[14] However, this potential limitation makes it conceptually more difficult to test the research questions in this study. This is because, as discussed, the sample taken from PM clients includes a high incidence of 'no reliance' situations where the underlying control strength, as discussed, is ambiguous. This ambiguity introduces error (noise) in the data. Thus, the significant relationships found in this study between assessed control strength and error incidence, financial impact, client size, and error cause are likely to be understated.

Additionally, cut-off may not be a natural consequence of the accounting system that processes daily transactions. Cut-off entails an artificially imposed effort to produce financial statements at certain intervals. Thus, poor cut-off may result from lack of timeliness in processing transactions or due to ineffective cut-off controls. Alternatively, cut-off errors may be present because of management discretion to reduce costs by relying on auditors to identify such omissions or to enhance the firm's financial performance (scenarios that can occur under all internal control settings). A further potential explanation for the common occurrence of cut-off errors may be the natural consequence of timing. Since the audit occurs after the end of the fiscal year, auditors have an extended time period to locate such transactions, for example, supplier invoices that were sent after year end. Thus, cut-off 'errors' may merely reflect the continuous nature of business operations and the fact that the accounting records must be closed prior to the audit. Evidence for this explanation is that the incidence of cut-off errors was substantially greater for firms having significant inventories—26.6% (merchandising and manufacturing companies) as compared with service clients—9.4% (banks, savings and loan, and insurance). This difference in cut-off errors presumably reflects underlying industry variations in the nature and related difficulty of recording of transactions; for example, merchandising firms need to account for the purchases, shipments and physical count of inventories (all of which can result in cut-off errors) that service firms do not.

A final potential reason for the unexpected relatively frequent occurrence of cut-off errors in strong control settings may be because control strength in this study was evaluated at the account level rather than at the assertion level. That is, perhaps controls may be considered strong overall for the account; however, nonetheless, there may be weak cut-off controls when examining individual assertions. SAS No. 55 (AICPA, 1988) requires an assessment of controls at the disaggregated assertion level. However, as discussed earlier, Waller (1993) found inherent and control risk assessments at the assertion level to be highly correlated.

In addition to the avenues of future research noted, more work is needed to better understand how auditors use their knowledge of internal controls, inherent risks and likely error patterns to arrive at programme planning decisions. The studies by Mock and Wright (1993), Bedard and Wright (1994), Bedard (1989), Libby et al. (1985), and Frederick and Libby (1986) are examples of early work in this area. A multi-method approach to this complex question seems appropriate (e.g., archival data from working papers, experiments and/or process-tracing approaches).

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Barriers to Interpretation—A Case Study of Philips Electronics NV

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Abstract—Philips Electronics NV, a very large European company, went through considerable upheaval in the period 1980 to 1994. Accounting disclosures did not seem to be very helpful to statement readers who wanted to evaluate Philips' progress and position. The company's financial condition and income results deteriorated significantly during most of the period, and large losses were shown in 1990 and 1992. Prior to the huge loss recorded in 1990, there were few indications in the annual reports that troubles were mounting. In earlier periods a series of accounting changes were made, the effect of which typically was to increase income. The most significant change came in 1992, when Philips abandoned current cost accounting. We investigated financial analysts' reactions to company disclosures and found that they had problems interpreting the effects of Philips' accounting changes. In addition to accounting changes, Philips also used a somewhat arbitrary restructuring charge (or credit) to adjust income amounts. Finally, the absence of full explanations from the directors at some points could have resulted in users of the annual report being misled. Over the period studied, Philips lost a significant portion of its stockholders' equity. The effect of its reporting practices was to obscure the impact of the unfavorable economic events that affected the company. Financial reporting, at least for this company, fell short of providing disclosures that told a clear story of what was taking place. In the periods before large losses were recorded, few hints were provided of impending disasters. Overall, the results of this study are disturbing. Although the study is restricted to one company, the results deserve the thoughtful consideration of both academics and practising accountants.

1. Introduction

The usefulness of accounting information is a concern shared by accounting educators, practitioners and investors. Usefulness is often investigated by looking at market reactions to information—including information about earnings, accounting changes and similar matters. This research is interesting and has produced some useful results, but it tends to abstract from the richness of the disclosure setting in which companies and investors operate.

This paper investigates whether the system works in the case of one company: whether users obtain information that clearly reflects the economic situation in which a company operates, and whether concepts such as full disclosure, true and fair view, and fair presentation are translated effectively into practice. We attempt to do this by examining the financial reporting of one prominent European company, Philips Electronics NV, over a period of 15 years.

There are several reasons why we chose Philips as the company to examine.

1. Philips is a large, complex Dutch company (the 12th largest in Europe in 1993, and 32nd largest in the world in sales according to the *Fortune* survey), and is widely traded.
2. Philips has been well-known for its use of current cost accounting in its basic financial statements for many years, although it changed to historical cost in 1992.
3. Philips has been recognised as a leader in financial reporting among Dutch companies (Zeff et al., 1992, p. 91).
4. The company has gone through turbulent times and experienced a very large loss in 1990 and another sizable loss in 1992.
5. The company has made a series of accounting changes over the years.
6. The company has used restructuring charges extensively, and this is an area of concern to standard-setters.

All of these factors provide disclosure and interpretation challenges to the company and users of its statements, and make the company an interesting subject for study.

We find the interpretation challenges to users to be all too real. Even though Philips has won sev-

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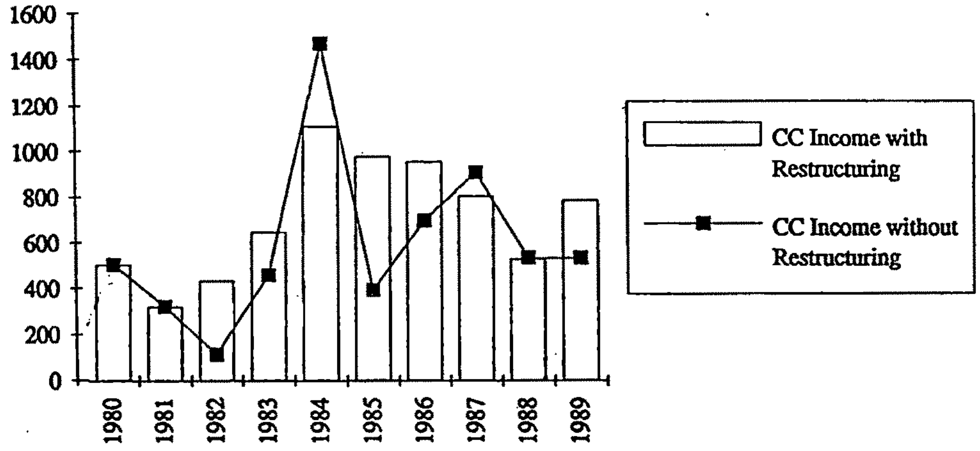
Table 1
Philips Income Measures, Stock Prices and Book Value 1980-1994 (Fl m, except for per share amounts)

Year	(1) Net income	(2) Net income before extraordinary items	(3) Net income before extraordinary items and restructuring	(4) Restructuring charge-net (credit)	(5) Stock price[3]	(6) Book value per share year end
1980	328	507	507[1]	524	18.20	75.80
1981	357	322	322[1]	99	22.80	77.96
1982	433	433	116	(317)	38.50	77.93
1983	647	647	459	(188)	48.40	80.01
1984	1,113	1,113	1,471	358	63.50	79.54
1985	919	980	393	(587)	64.20	71.30
1986	1,015	959	701	(258)	49.00	68.20
1987	818	809	910	101	29.50	60.78
1988	1,056	531	535	4	37.00	64.16
1989	1,374	792	536	(256)	40.50	61.09
1990	(4,240)	(4,526)	(1,534)	2,992	27.50	37.69
1991	1,202	981	(1,019)	(2,000)	37.00	37.72[4]
1992[2]	(900)	(900)	(209)	691	23.60	28.88
1993[2]	1,965	856	554	(302)	55.20	34.94
1994[2]	2,125	2,049	1,601	(448)	53.30	37.62
Average % change	28%	34%	93%		28%	
Range	9-72%	2-72%	0-296%		1-69%	

[1] Treatment of some restructuring as an extraordinary item in these years means that amounts without restructuring are only an estimate. Exact amounts are not determinable.
[2] Historical cost, no current cost figures available.
[3] Stock price after annual report release, typically second week in March.
[4] Restated to historical cost, the figure is 32.51.
Average % change is average absolute percentage change each year from 1980 to 1989.
Range is range in percentage change in period 1980 to 1989.

Figure 1 Philips Income before Extraordinary Items with and without Restructuring



eral prizes in the Netherlands for its annual reporting (the most recent being in 1986), the financial information is complex and difficult to understand, changes make comparisons difficult from year to year, smoothing activity seems to have taken place, even analysts have trouble interpreting the information, and information on the change from current cost to historical cost leaves a great deal to be desired. Close study of the financial reports does not provide the clear picture of company position and operating results that users would like to have. This may be attributable in part to complexity of operations, but we believe that it may also have been the result of accounting practices and company comments that at some points appear to be misleading.

In this study we look first at Philips' abandonment of current cost accounting and other accounting changes, and discuss analysts' reactions. We then demonstrate that some smoothing takes place (through the restructuring provision), and examine the handling of losses. Our focus is on Philips' disclosures, not on analysis of why charges and changes were made. We explore interpretability, usefulness and completeness in disclosure, and comment only briefly on the nature of, and rationale for, Philips' policies (Brink, 1992 and others have explored these aspects).

2. Abandonment of current cost accounting

Along with the large loss recorded in 1990, and the accompanying need for continuing changes in the company, Philips at the beginning of 1992 abandoned the current cost accounting approach that it had been using for many years. It did so with barely a murmur. The annual report refers to a need to 'improve communications with shareholders, considerably simplify our accounting systems and procedures, and be more in line with current international accounting practices' (p. 26). Philips states that the abandonment of current cost accounting was one response to this need. Earlier, in 1983, R.C. Spinosa Cattela, managing director and chief financial officer of Philips (1983, p. 43), extolled the current cost system and concluded that it 'has all the features to meet the objectives of good reporting, because it provides insight into trading profits, the effects of the financial structure

Table 2
Philips' Operating Income (Fl m)

Year	*CCOI*	*CCOI/RS*	*HCOI*	*HCOI/RS*
1980	1,577	1,672	2,317	2,393
1981	2,193	2,079	2,903	2,789
1982	2,130	1,813	2,875	2,558
1983	2,755	2,567	3,369	3,181
1984	3,473	3,831	3,839	4,197
1985	3,075	2,488	3,504	2,917
1986	3,194	2,936	3,427	3,169
1987	2,445	2,546	2,324	2,425
1988	2,428	2,432	3,108	3,112
1989	2,294	2,038	2,776	2,520
1990	(2,389)	603		
1991	2,985	985	3,069	1,069
1992	—	—	1,286	1,977
1993	—	—	2,565	2,263
1994	—	—	3,758	3,310
Average % change 1980-1989	16%	24%	16%	20%

CCOI = current cost operating income, including restructuring items (per financial statements).
CCOI/RS = current cost operating income without effects of restructuring (per calculation).
HCOI = historical cost operating income, including restructuring items (from financial statements, except amounts were not given in 1990).
HCOI/RS = historical cost operating income without effects of restructuring (per calculation).

Note: HC amounts are taken from Philips' reports and were described therein as 'Data based on historical cost'. In 1989, the description was changed to 'Data based on generally accepted accounting principles in the USA'. The HC figures for all periods may differ from CC in more respects than simply current versus historical amounts; for example, in the treatment of operations in hyperinflationary economies. When Philips changed to HC in 1992, most provisions of US principles were adopted.

Table 3
Philips — Correlation Matrix Income Measures 1980-1989

	CCOI	*HC*	*HCOI*	*CC/R*	*CCOI/R*	*HC/R*	*HCOI/R*	*RS*
1 CC	0.58	0.82*	0.40	0.54	0.50	0.24	0.38	−0.28
2 CCOI		0.63	0.88**	0.19	0.88**	0.11	0.81*	−0.31
3 HC			0.64	0.55	0.60	0.12	0.67	−0.15
4 HCOI				0.07	0.73*	0.12	0.87**	−0.32
5 CC/R					0.19	0.89**	0.44	0.63
6 CCOI/R						0.52	0.90**	0.17
7 HC/R							0.54	0.79*
8 HCOI/R								0.14

*Significant at 0.01
**Significant at 0.001.
CC = current cost net income.
CCOI = current cost operating income.
HC = historical cost net income.
HCOI = historical cost operating income.
/R = indicates measure without net restructuring charge or credit.
RS = net restructuring charge.

(interest and currency) and the fiscal consequences'.

He and others held the belief that the system was superior to a historical cost system that ignored the current economic significance of financial elements. Did Philips have a change of heart? Did new circumstances make the system obsolete? Was an emphasis on maintenance of capital in terms of productive capacity no longer appropriate? Are there some ways in which the new approach provides superior information? Was the higher income that historical cost is likely to provide an important factor? No discussion is included in the report on these issues and the important change in philosophy that is involved.

Perhaps Philips thought that most readers would not understand the implications of the change, but to say virtually nothing about the implications seems odd to us. We believe Philips should have been more forthcoming in its explanation of the change from current costs.

The financial press did include some reactions to Philips' change to historical cost. One article, after describing the changes, gives a typical reaction: 'In an accounting technical sense, all this can be regarded as a step backwards. But when it all becomes so complex that only a specialist can understand it, then it can be said that they have missed their objective. And the less perfect but more understandable method used now should be preferred primarily because it increases comparability with other companies'. (*Het Financieele Dagblad*, 1992, p. 3).

Before describing how Philips handled the change, it is helpful to look at the balance in stockholders' equity at the end of 1991. The figures were as follows:

Stockholders' equity of Philips—31 December 1991:

Contributed capital		5,830m
Revaluation surplus		
Realised revaluation	9,045	
Unrealised revaluation adjustment	1,013	
Deferred gearing adjustment	1,120	
Income taxes related to price level adjustments	(688)	
Total		10,490
Retained earnings		7,554
Goodwill		(2,942)
Foreign exchange translation differences		(9,397)
Total		Fl 11,535m

The revaluation surplus is a unique amount that arises from use of current value accounting. The revaluation adjustment and the gearing and tax amounts arise as asset prices increase over their historical cost. The revaluation amount is realised as the revalued assets are depreciated or used and is then transferred to realised revaluation, rather than being shown in income. This reflects a philosophy of maintaining physical capital. The gearing adjustment is based on the proportion of the revaluation financed by debt, and is transferred to income as assets are depreciated or used. The income tax amount is the deferred tax relating to the revaluation and the gearing adjustment. The portion related to the gearing adjustment offsets part of the amount carried to expense as assets are depreciated or used.

The goodwill amount is the cumulative total of goodwill on business acquisitions, charged directly to owners' equity by Philips. This procedure is permitted by Dutch accounting standards, and is common in the Netherlands.

Table 4
Philips Income and Cash Flows (Fl m) 1986-1994

Year	*Income before extra-ordinary items*		*Cash flow-operations*		*Capital expenditures*
	Amount	*% change*	*Amount*	*% change*	
1986	959	–	2,533	–	4,667
1987	809	−16	3,398	+34	4,756
1988	531	−34	365	−89	4,145
1989	792	+49	1,203	+230	4,133
1990	−4,526	−671	4,256	+254	3,537*
1991	981	NM	3,414	−20	2,956
1992	−900	−192	3,631	+6	3,330
1993	856	NM	5,734	+58	2,576
1994	2,049	+239	5,029	−12	3,541

*Accounting changes mean that amounts are not completely comparable to preceding years.
NM = not meaningful.
Figures for years prior to 1986 are not available for some amounts, and thus no comparisons are possible.

The foreign translation adjustment deduction relates to both (a) operations in foreign countries in which there has been a decline in value of the foreign unit of account, and (b) amounts that are related to the revaluation surplus. If an asset is revalued upward in a foreign country, revaluation surplus is generated. Then when the asset and related owners' equity are translated, the translation difference will tend to be larger.

One reason Philips gave when it abandoned current value accounting was to simplify accounting systems and procedures. It is fair to say that the typical reader would have a difficult job trying to trace through effects of the various current cost adjustments on particular items in the income statement. Considering this as well as the amount of assets involved (which would have to be revalued each year), the complications arising from operations in inflationary situations, and the gearing and tax effects, it is easy to see that simplification would result. It should be noted that the net unrealised revaluation surplus (the part that had not yet been realised through sale or use) only amounted to about Fl 1.4bn at the end of 1991 (total revaluation surplus Fl 10,490m less realised surplus of Fl 9,045m—also see 1991 Annual Report, p. 48). Thus the change did not involve radical revisions of statement amounts. The recent fairly low level of general inflation, together with an industry in which costs were continually being driven down, combined to reduce the difference between the two systems.

The net adjustment from current cost to historical cost results in a charge of Fl 1,595m to stockholders' equity, and is described as the result of 'changes in accounting policies' (p. 50). Examination of other notes reveals that the Fl 1,595m net adjustment was made up of a reduction in tangible fixed assets of Fl 2,164m and in the related deferred tax provision of Fl 497m, and some other minor adjustments totalling Fl 72m. Although adjustments to assets are clear, it is difficult to reconcile the total change of Fl 1,595m with the difference between total revaluation surplus and realised revaluation, which amounts to only Fl 1,445m, and with the details of revaluation surplus at the end of 1991 (see stockholders' equity schedule above).

Comparisons to prior years in the 1992 annual report were aided by presenting 1991 comparative figures on the new basis as well as the old. However, summaries for earlier periods presented in the statements were not restated to the new basis. Some of these amounts were available through disclosures in earlier annual reports of income under a historical cost basis and/or could be calculated from amounts that the company developed in connection with US Securities and Exchange Commission Form 20F filings.

Changes in 1992 included not only changing from current value, but also using US generally accepted accounting principles (GAAP) in accounting for highly inflationary countries, and capitalising new goodwill and certain software development costs (p. 26). The company did not retroactively change past accounting for goodwill, but instead adopted capitalisation and amortisation only for goodwill on new acquisitions, which amounts to selective adoption of the new principle. If Philips had not done this, income would have been burdened with substantial charges, amounting to Fl 231m in 1991, according to Form 20F for that year.

Investment analysts discussed the 1992 accounting changes, especially the one from current cost accounting to historical cost, quite extensively. We examined the investment reports of six Dutch investment analysts, one of whom even wrote a separate report (three pages) devoted to the accounting changes and their effects (ABN–AMRO, 1992). In spite of the theoretical superiority of current cost, the analysts appeared to be pleased with the change to historical cost. Statements like: '...the greatest impact of the change on the P&L was the removal of two very opaque headings called the "monetary adjustment" and "gearing adjustment" ' and '...the changes should make Philips' numbers more easily comparable and more readily understood' are typical (Capel, 1993, p. 2 and Barclays, 1992, p. 7). Furthermore, it is interesting that none of the investment analysts criticised the fact that the accounting change with respect to goodwill was not adopted retroactively, although they noted the change.

Instead of the detailed information on consolidated stockholders' equity (for the Philips Group) that had appeared in notes to the statements in 1991 and earlier years, Philips in 1992 discontinued providing information on balances of items such as retained earnings and cumulative translation adjustments, and only provided information on *changes* in total owners' equity in statement notes.

Using these changes, one can compute what has happened to retained earnings since 1991, but it is difficult to be sure what the final balance is. The detailed information on balances simply disappears in 1992. Discussion is severely limited, although reference is made to notes of the parent company (p. 60), where amounts are given for paid-up capital, share premium, legal reserves and other reserves, and where it is indicated that the loss for the year was charged to the legal reserve.[1] Similar lack of disclosure of balances continues in the 1993 and 1994 reports.

As a result of the recording of the transactions and the display of reserves in the financial statements, it is difficult to determine the balance of retained earnings, the translation adjustment and goodwill amounts. The difficulty is exacerbated by the strong possibility that, in changing to historical cost, Philips would have closed out several earlier balances, and the retained earnings amount could have been affected. Although the reader may be confused as a result, it might be argued that the rather severe contraction of owners' equity that appears to have taken place (from Fl 16,888m at the end of 1989 to Fl 9,071m at the end of 1992) speaks rather eloquently of Philips' situation. It is interesting to note that of this reduction of Fl 7,817m, Fl 3,938m came because of net losses over the three years 1990 to 1992. The rest occurred largely because of the change to historical cost (Fl 1,595m) and an increase in the (no longer disclosed) foreign translation adjustment balance (Fl 1,765m).

Our conclusion about the sweeping accounting changes in 1992 is that they were inadequately disclosed and discussed. Furthermore, a reader interested in comparisons and trends over the years is given little help by the company reports.

3. Other accounting changes

Although the 1992 accounting changes were exceptionally important, Philips also had several other accounting changes during the period studied (1980–1994). This was not unusual for Philips. In fact, in a study on changes in accounting principles in 1977–1986 financial statements of 138 Dutch listed companies, it appeared that Philips adopted the most accounting changes of any major Dutch company (Hoogendoorn, 1990). Six of the 10 annual reports contained at least one accounting change, while the total number of changes amounted to 14. It appeared that net income typically was increased due to the accounting changes.

During the period 1980–1994, a number of important accounting changes were instituted, particularly in the 1981, 1989 and 1992 statements. The 1992 changes were discussed previously, and we now turn to the 1981 and 1989 changes.[2]

3.1. 1981 Changes

In 1981 Philips adopted five important changes in accounting principles.

1. The gearing adjustment was introduced as a credit to income in the current cost accounting system. The result is that when revaluation surplus on assets is realised as a result of sale or use, the amount realised, to the extent not financed with shareholders' equity, is credited to income.
2. Deferred income taxes connected with the realised revaluation of assets are no longer carried in the revaluation reserve, but are accounted for as tax expense.
3. The exchange differences on the net investment in foreign subsidiaries are accounted for as a change in shareholders' equity (instead of being reflected in income).
4. The provisions for obsolete inventory and bad debts are fixed at the level of the estimated risk at the end of each financial year. Previously, net

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[1] Legal reserves restrict payment of dividends by the parent company when claims to subsidiary retained earnings are restricted in some way. Philips Electronics NV is a holding company. Thus, in the parent company's financial statements, the losses of the subsidiary companies reduce legal reserves, because the losses reduce the retained earnings of the subsidiary companies. Philips closed out the legal reserve category in parent company statements in 1993.

[2] Brink (1992) gives an overview of the choices and changes Philips made with respect to accounting principles from 1912 (the year of Philips' first annual report) up to and including 1989.

favourable differences were generally not adjusted each year.

5. The provision for the lifetime risk of fixed assets is eliminated. This provision was previously used to equalise differences between estimated and actual useful lives–a smoothing device.

Philips discussed the reasons and the theoretical background for these accounting changes rather extensively, especially for accounting changes (1), (2) and (3). Philips quantified the effects of the accounting changes by adjusting 1980 comparative figures to the newly-adopted accounting principles. With respect to 1980, for example, it appeared that due to the accounting changes, net income rose from Fl 328m to Fl 345m. Philips did not disclose the effects of the accounting changes on the 1981 figures.[3] This was an interesting approach, because the picture would be quite different if Philips had quantified the effects of the accounting change by giving the 1981 figures based on the old accounting principles. In the 1981 report a net income figure of Fl 357m was presented.

Hoogendoorn estimated what the effects of the accounting changes would be in 1981, applying the old accounting principles (1990, p. 379). He distinguished a 'best case' and a 'worst case', depending on tax effects. In the 'best case', the 1981 income figure would be Fl 703m lower, and in the 'worst case', Fl 1,147m, resulting in a net income figure between Fl -346m and -790m.[4] Thus, instead of the increase in income that Philips presented in 1981—after having presented declines in 1979 and 1980—net income without the changes would have deteriorated further and have become a loss. This assumes that the restructuring charge of Fl 525m in 1981, a discretionary item, would have been the same.

Hoogendoorn (1993, p. 58) examined the financial press's treatment of the accounting changes that Philips adopted in its 1981 statements. It appeared that journalists paid especial attention to accounting changes (1), (2) and (3), discussing extensively the theoretical backgrounds of those accounting changes. However, none of the journalists discussed the fact that Philips would have presented a loss instead of an increase in net income—after two years of decline—if it had not adopted the accounting changes. On the contrary, headlines like 'Philips does not polish its results' ('Philips poetst resultaat niet op') and 'Philips is recovering' ('Philips is door het dal') reflect the contents of these articles on Philips' performance in 1981. We conclude that the 1981 disclosures hindered some analysts in reaching valid conclusions about what was happening to the company. Admittedly, the changes were technical, and perhaps obscure in nature, but the disclosures did not present as clear a picture as they should have.

3.2. 1989 Changes

In 1989, Philips adopted three changes in accounting principles. The accounting changes involved determination of the cost of pension benefits, the gearing adjustment in highly inflationary countries and the treatment of catalogues of recorded music. The first two accounting changes affected 1989 net income. Because the effect, if any, of the last of these changes on 1989 net income was small, it is not discussed further. Philips states that amortisation of catalogues will depend on whether net realisable value falls below book value (1989 report, p. 16). Effects in later years are difficult to determine because they are part of a combined total in the annual reports.

Philips decided to calculate the cost of pension plans in conformity with the US Statement of Financial Accounting Standards No. 87 (SFAS 87), i.e., the future trends in salaries and the expected rate of return on investments were now taken into consideration. In accordance with SFAS 87 (para. 77), the differences between the value of the plan assets and the existing provisions are accounted for in the income statement and spread over the remaining years of service. Due to the accounting change, pre-tax income for 1989 rose by approximately Fl 260m. Using the nominal tax rate of 35% as a base, this would be an increase of about Fl 170m in net income. Effects of this change on future income were favourable as well (see Brink, 1991).

In regard to the gearing adjustment, in highly inflationary countries an asset increase is likely to be caused primarily by high general inflation, and this will also lead to high interest rates on debt. For that reason, Philips decided to account for the gearing adjustment in highly inflationary countries directly in income under financial income and expenses. The tax effect on the increase in value is charged to income at the same time. As a result of the accounting change, the related balances as of 1 January 1989, of deferred gearing adjustment and income taxes, were recorded as non-recurring items in the 1989 income statement, resulting in an increase of 1989 net income by Fl 83m (more than 6%). This amount is actually the cumulative effect of the accounting change but is presented as an ordinary item in the income statement. The current year effect was not disclosed in the annual report. The Fl 260m pension adjustment and the Fl 83m gearing adjustment by themselves increased 1989 income by Fl 343m.

We examined to what extent four journalists of the financial press and 10 investment analysts employed with banks or firms of stockbrokers dealt with the accounting changes in their analyses. It appeared that only a few journalists or investment analysts discussed the accounting changes and their effects on income figures. The change in accounting for the cost of pension benefits was noticed by three of them, and the gearing adjustment by four of them. None of the journalists or analysts discussed how the newly-adopted accounting principles differed from the old ones. This might be due to the perceived complexity of Philips' financial statements in general, and the two accounting changes in particular. Some investment analysts admitted explicitly that they did not understand Philips' statements fully. One investment analyst talked about a 'porridge of figures' ('cijferrijstebrij') when discussing the 1989 figures, and another referred to the accounting change with respect to the gearing adjustment as 'a mystery' and the gearing adjustment itself as 'an enigma' (Beleggers Belangen, 1990, p. 12 and Capel, 1990, p. 3).

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[3] US principles require that the effect of the change on income of the period of the change be disclosed. See APB Opinion No. 20, para. 19.

[4] Because the tax effect amount was not provided, the precise number is difficult to determine.

In March 1990, Philips stated that it expected an improvement of the results in 1990, but three months later this expectation was adjusted downward dramatically; instead of a net profit of more than Fl 1.3bn, it was indicated that a net loss of about Fl 2bn was expected. One investment analyst later referred to the 1989 accounting changes when discussing the underlying problems with respect to the realisation of the original 1990 forecast. In his report he states: 'It is also worth pointing out that the 1989 financial year benefited from a number of special factors which made earlier predictions of another good year in 1990 that much more difficult to achieve. These special benefits included the following: the sale of Philips' Paris HQ for Fl 348m, the introduction of new pension methodology, which caused pre-tax income to rise by Fl 260m, a net non-recurring Fl 83m gain relating to the gearing adjustment/taxes, and a Fl 66m reduction in research and development expenditures compared with 1988' (Barclays, 1990, p. 4). Although this analyst seems to have a clear idea of what is happening at Philips and how adoption of the accounting changes affected results, we believe most analysts and readers were confused and found themselves wading in a 'porridge of figures.'

4. Restructuring provision and smoothing

In addition to accounting changes that increased reported income, another interesting feature of Philips' annual reports is the use of a restructuring provision over the years. Similar provisions have been used by other companies throughout the world. Recently, standard-setters, especially in the US, and regulators such as the US Securities and Exchange Commission, have been trying to develop standards for these charges. They have tried to restrict use of charges to amounts that have been clearly identified and are incremental to normal costs (see for example EITF Update, 1995).

Philips utilised restructuring changes extensively. Income is charged and provisions (liabilities) are credited each year. Subsequently, the balance sheet provision is reduced and assets are reduced (or specific liabilities credited) as provisions are used up. The income effect in any year is the difference between these two amounts. In 1980 and 1981, unusual restructuring amounts were shown separately as extraordinary items (gross amounts of Fl600m in 1980 and Fl525m in 1981) and other amounts appeared as part of operations. The restructuring charge was included as part of the costs used to determine trading profit or income from operations from 1982 until 1990. Net amounts that affected income ranged from Fl4m in 1988 to almost Fl600m in 1985.

Beginning in 1990, when amounts were substantially larger, the restructuring amount was shown separately and figures were given for income from operations before and after restructuring. (Note the huge charge in 1990 in Table 1.) This presentation is actually somewhat misleading because amounts charged to the provision in the year, which reduce operating expenses, are not combined with the restructuring charge. Thus the amount shown is the gross amount added to the provision, which overstates the effect of yearly use of the provision.

The restructuring provision was apparently used as an income-smoothing device. The difference between the amount expensed and the asset reductions charged to the provision represent a means of adjusting income amounts from year to year. The pattern of the increases and charges in the provision over the years involve income effects (the net of changes in the provisions) that are shown in Table 1.

Several points can be made about Table 1, in addition to the general point that the Philips income picture is confusing. In Columns 1 and 2, extraordinary items are prominent in a number of years. In Columns 2 and 3, one gets a very different impression of the trend in earnings from the income before extraordinary items including restructuring (Column 2) and income without restructuring (Column 3). The income series is smoother for Column 2 than for Column 3, as evidenced in part by an average year-to-year percentage change (to 1989) for Column 2 of 34% compared to 93% for Column 3 (see Figure 1 for a graphic representation of this point). Note particularly that (a) without the restructuring item 1982 income in Column 2 would have decreased instead of increasing, (b) 1984 was a good year and reported income in Column 2 was reduced through the restructuring charge, (c) the credits in 1985 and 1986 helped cushion the apparent decline in Column 2 earnings for those years, and (d) enough of the balance was used in 1989 to provide a 49% increase in Column 2 income over 1988—which does not appear to be smoothing behaviour in relation to 1988, but does provide an income amount close to those of 1985 to 1987.

In Column 3, the restructuring provision was used to reduce the change from previous years except in 1983, the effect of which was to increase income (and continue an upward trend); 1987, where the change increased the difference; 1988, where the amount was immaterial; and 1990 and after, which were affected by the huge provision connected with 1990 income.

The 1990 loss was almost tripled by the Fl 2,992m increase in the restructuring provision. The reported income for 1991, on the other hand, would have been a loss had it not been for amounts charged to the restructuring provision. The 1990 loss and its effects are discussed more fully below.

5. Massive loss in 1990

Philips took a huge loss (Fl 4,240m after extraordinary items, Fl 4,526m before) in 1990. How the loss was handled in 1990 is interesting. Much of the loss was reflected in the increased balance in the provision for restructuring (Fl 2,992m), instead of by reducing assets or crediting specific liabilities (Fl 1,657m). The effect is noticeable in the statement of changes in financial position for 1990, in which cash provided by operating activities before dividends amounts to Fl +4,256m—a healthy increase over the Fl +1,203m of 1989.

1990 appears to be a classic example of the big bath, with large charges that involved not only expenditures and write-downs in 1990, but also provisions for future expenditures and specific write-downs in later years. The large charge in 1990 in fact provided a convenient means of reducing later operating charges. For example, the 1991 income figure would have been a loss if large amounts had not been charged to the restructuring provision during the year. Specifically, in 1991, Fl 2,073m was charged to the restructuring provision, new provisions of Fl 73m were set up, net income was Fl 1,202m, and without the net restructuring adjustment of Fl 2,000m, 1991 would have shown a loss of Fl 798m (Fl 1,019m before extraordinary items) instead of a profit.

There is, of course, no way of determining what amounts should have been charged to each year, but the fact that the restructuring provision changed by exactly Fl 2,000m in 1991 leads one to wonder whether the net charge was determined arbitrarily in this and other cases.

5.1. Premonitions of disaster

When a company experiences a large loss, it is important to see whether the loss might have been predicted from the financial statements. The 1989 annual report showed an income of Fl 792m before extraordinary items, and a net income of Fl 1,374m. The notes indicate that margins were down in every segment except consumer products. Operating profit in total was down 5.5%. A reduction in the restructuring provision contributed Fl 256m to operating results for the year, and made the year look somewhat better. As indicated earlier, accounting changes and special items also increased operating income, which would have been lower otherwise.

The president's foreword points to a 30% increase in income (net income in this case), and states that the company achieved its 'objective of step-by-step improvement in our results and enhancing our competitiveness' (p. 4). It further states: 'The upward trend in our net income is a good indication that the changes which we have carried out over the past few years are now beginning to bear fruit, despite the fact that we had to implement these changes in a period in which the competition in the market was extremely fierce' (p. 5). A reader who analyses the report carefully will note that without the restructuring adjustment, income before extraordinary items would have been flat and without accounting changes would have been lower.

Other parts of the report, while painting a less glowing picture than the president did, are scarcely less misleading. The outlook section sounds a precautionary note when it says that a slowdown in economic activity is expected throughout the world, particularly in the US. But it also states that growth is expected in most areas of Philips' business. In two problem areas the company is optimistic. In professional products and systems, after noting that prices fell considerably as a result of fierce competition (p. 8), it says: '... We anticipate a modest increase in sales volume, with an improvement in income' (p. 36). Unfortunately, in 1990 the company experienced a 17% drop in sales and 86% drop in income in this segment (or a loss of Fl1,306m after restructuring).

For components, the company talks about intensified competition and the fact that the sector as a whole was under pressure, but expects roughly the same percentage of sales growth as in 1989. It baldly states: 'There will be a return to profitability...' (p. 37). The actual result was a 4% drop in sales and an operating loss that was Fl −101m in 1989, and went to Fl −11m before restructuring loss or Fl −1,543m after in 1990. Overall, the company indicates an expectation that groups that were profitable in 1989 would continue to show improvement and that for those groups faced with problems '...we envisage an improvement in income...' (p. 37). This did not occur.

5.2. Per Share Amounts

The stock price reaction to all these events can be seen in part in Table 1. Stock prices after the annual report release increased from 1980 to 1985, but then dropped 54% in the next two years, while reported income before extraordinary items dropped 17%. Stock prices in 1987 should be interpreted in light of the crash in share prices in October 1987. The stock price then rose 37% from 1987 to 1989. Even at this level, the share price was well below that in 1985, perhaps as a result of the market recognising the increasing problems facing electronics companies. The price then dropped 32% by the time the report was issued in 1990, the loss year. This drop indicates that in earlier periods the market did not fully anticipate the loss that Philips reported. The stock price hit a low for 1992 and then increased 134% up to the time the 1993 report was issued. Table 1, Column 5 indicates that movements in share prices in the last few years have been substantial.

Book value per share (Table 1, Column 6) reached a high of Fl 80 in 1983, dropped to around Fl 60 in the late 1980s, and then declined about 40% as a result of the 1990 loss. By 1993, book value had started to increase again, but at that point was still less than half of what it had been in 1980. Philips was in this respect a different company in the 1990s than it had been earlier. Fluctuations in book value were not as pronounced as those in stock market prices.

5.3. Change in Top Management

Philips changed its top management in 1990, replacing its president early in July. Part of the problem was deteriorating conditions for the company, with which the previous management had not been able to cope. There was also some complaint that previous management did not keep shareholders informed of what was happening. In the 1990 annual report, there is a section (p. 15) explaining that Philips paid slightly over $9m to American shareholders to settle a suit in which the shareholders claimed that first quarter 1990 results did not correspond to earlier pronouncements by leading company spokesmen. The then president had stated that results would be good for 1990, and actual results were far from good. Did the company know that things were going bad before 1990, or were its optimistic statements justified on the basis of knowledge at that time? This question cannot be answered definitively, but deteriorating margins should have led to more caution than was expressed by officials in the 1989 report.

The 1990 annual report, which shows a net loss before extraordinary items of Fl 4,526m compared to a profit of Fl 792m in 1989, has the task of explaining what happened in the face of the generally optimistic outlook provided by the 1989 report. The foreword, by the (new) president, states: 'The economic outlook, which was already less than rosy, appeared to be deteriorating in the first two months of this year as a result of the Gulf War.' Persistently large losses on information systems and integrated circuits, and intense price competition in lighting in Europe and the US, were cited, as well as exchange rate movements and appreciable rises in interest rates. The president states: 'Against this background it was decided that the measures taken in the past few years to enhance the company's manoeuvrability should be radically intensified and speeded up' (p. 8).

5.4. Later Statements

The 1991 president's foreword is fairly cautious, although improvements in productivity are mentioned prominently. He states: '...it is advisable to hold out the prospect of only a limited increase in sales and net income from normal business operations for 1992' (p. 7). This caution is commendable, because Philips reported a loss of Fl 900m in 1992, helped along by a charge for restructuring of Fl 691m net (Fl 1,200m as a gross charge in the income statement less amounts charged to provisions of Fl 509m). The loss is on a historical cost basis, and compares with a profit on the same basis in 1991 of Fl 878m before extraordinary items (Fl 981m on the old current cost basis). The president refers to '...rapidly deteriorating profits in the consumer electronics business and a reasonable profit performance elsewhere, in spite of low sales growth.'

Currency weaknesses are also cited. Reference is also made to profit warnings issued in the course of 1992 when effects of these severe problems became apparent (p. 12). The outlook for 1993 is expressed very cautiously: 'Given the major uncertainties, we refrain from making predictions of the group's income' (p. 13). This cautious approach continued in the 1994 report. In 1993 and 1994 there was a return to profitability both for net income and income before extraordinary items, as well as in income before restructuring adjustments.

A gross amount of exactly Fl 1,200m as a charge for restructuring in 1992 does not point to a very exact knowledge on the part of the company about specific costs of restructuring. In fact, in the president's foreword, it is stated that half the provision is for general uncertainties. The suspicion that the figures are approximations is further confirmed when it is noted that the president's foreword refers to a provision for restructuring of Fl 1,000m in 1992 instead of the actual Fl 1,200m amount shown in the income statement. The discrepancy appears to be an error in the report, which may have occurred because a Fl 1,000m provision was first made and then a decision was made to change the amount (Fl 1,200m) for some reason—a reason not connected with precise calculations. Note that a larger provision in a loss year can be used to improve reported income in later years.

5.5. Income Series

The previous discussion is related to an interesting point in connection with Philips' report. What income series is one to use for analysis? The choice is large and includes the following possibilities:

a) Reported net income for each year.
b) Net income as reported for the current year and restated amounts for earlier years (as a result of acquisitions, etc.).
c) Income before extraordinary items for each year.
d) Income before extraordinary items with restated amounts for earlier years.
e) Income before net restructuring charge.
f) Income before extraordinary items and net restructuring charge.
g) Income from operations.
h) Income from operations before restructuring.
i) to p) Historical cost net income with all the variations listed.
q) US GAAP net income (from form 20F).
r) Cash flow from operations.

This is a bewildering array of choices, and each series is different. Accounting changes (discussed earlier) further complicate the picture, as do acquisitions and dispositions, which occurred in most years for Philips. The US GAAP figures separate discontinued operations and also classify extraordinary items differently than in Philips' annual report, which adds some other possible income series.

Figure 1 displays two income series. It shows current cost income before extraordinary items for each year from 1980 to 1989 compared with income before extraordinary items and net restructuring charges. 1990 and later years are omitted because of the very large restructuring charges and credits, and their distorting effect on the income series. From visual inspection it is apparent that the graph of income before extraordinary items (including restructuring) is smoother than that of income without restructuring.

Table 2 compares current cost operating income and current cost operating income without including net effects of restructuring amounts, and also historical cost operating income with and without net restructuring. It can be seen that (1) historical cost operating income was typically larger than current cost income; (2) until 1990, amounts including restructuring do not vary as much as those without restructuring—the average percentage change from 1980 to 1989 in operating income excluding restructuring effects is larger than amounts including the restructuring, supporting the use of restructuring as a smoothing device; and (3) effects of the restructuring charge or credit are less dramatic than in the case of net income (Figure 1), as might be expected.

A series of correlations was run among various income measures for Philips for the period 1980–1989. The large charge in 1990 and its effects on subsequent years exert a strong influence on trend lines and relationships, and thus years after 1989 are not included in the following comparisons. However, results are generally similar for the period 1980–1992 (current cost amounts are not available after 1992) except for relationships between measures with and without the restructuring charge, which are generally much weaker. In the correlation matrix in Table 3, the first four items are measures of income with the restructuring charge or credit included. Items 5 to 8 are the same items with the restructuring amount excluded. Although data limitations make the correlations somewhat suspect, the following points can be noted:

1. All the operating income measures, CCOI and HCOI, with and without restructuring, are significantly correlated with each other. Thus a similar income pattern exists for both CCOI and HCOI. Also, the restructuring items do not affect the correlations. This consistent pattern does not hold for net income.
2. The CC and HC net incomes including restructuring are correlated with each other, as are the CC and HC net incomes, excluding restructuring.
3. Correlations of CC net and HC net (which include restructuring effects) with income measures excluding restructuring are *not* significant, and in some cases are quite low.
4. Correlations of net income measures with operating income measures are not significant, and in some cases are quite low. Thus Philips' other charges and credits do have an effect on the income series.
5. The restructuring charge is negatively (but not significantly) correlated with income measures, including restructuring.

These points reinforce our conclusions that (a) use of restructuring, other charges and credits, and accounting changes allowed Philips to produce income series that differ in many respects from unadjusted numbers, and (b) these differences in income series are difficult to analyse and could lead to misleading inferences on the part of statement users.

6. Cash flow

One aspect of operations that is of interest to investors is cash provided by operations. Cash from operations for Philips is only available from 1986. Income reported, cash flows generated (before dividends) and gross capital expenditures are given in Table 4 for 1986 to 1994.

This table indicates substantial differences between income movements and movements of cash flows from operations. What appears to be an awful year for income, 1990, is the best year before 1993 in terms of cash flows. Fluctuations in cash flows in the years 1988 to 1990 are substantial. The 1988 figure is heavily influenced by a Fl 3,700m increase in working capital other than cash. In 1989, there was a similar increase in this balance of Fl 2,100m. In 1990, the balance decreased by Fl 1,700m, a swing of Fl 3,800m in one year. The provision for restructuring was, of course, a non-cash item in each year, and had a major effect in 1990 and 1992. Capital expenditures from 1990 on declined substantially (with some upswing in 1994), which has implications for future growth. The questions raised by these amounts in Table 4 are, first, how is one to interpret what happened? and, second, are cash flow figures useful in interpreting the company situation? We have no definitive answers, but we note the radical differences between cash flow from operations and income figures, and the wide swings in cash flow figures, which add to evaluation difficulties.

7. Conclusions

Philips Electronics experienced difficult times during the period 1980–1992, with some recovery evident in 1993 and 1994. The financial statements up to 1989 gave limited indications of the troubles the company was experiencing because company disclosure policies had the effect of obscuring the impact of unfavorable economic events that affected the company. One has to search the financial statements before 1990 for intimations of the calamity that was revealed in 1990, when a huge loss was reported. Prior to the loss year, the company adopted a series of accounting changes which had the effect of increasing reported income and made comparisons difficult, and then provided limited information about these changes. Also, a restructuring provision was used to smooth income (it continued to be used to shift income among periods through 1994). Later, in 1992, Philips' reporting of the major change from current cost to historical cost accounting left a great deal to be desired, and the company provided little information about why the change was made and effects of the change on income series.

How useful are Philips' annual reports? The many different income computations that were possible, the lack of correlation among many of these measures, and the resulting difficulty in interpreting trends and developments, all combine to make the message that the statements convey quite obscure. Remarks by company officials in annual reports prior to 1990 did not help. Yearly stock market prices rose until 1985 and then dropped 37% in the late 1980s, reflecting market concerns about prices and competition. But prices fell a further 32% from the 1989 level when the large losses of 1990 surfaced. Substantial losses were incurred by those who held shares, although substantial price gains were available to those who held shares after 1992. The company's financial reporting apparently did not facilitate evaluation by holders.

It is perhaps true that Philips' reporting is not much different from that of many other companies that experienced hard times. But this is no reason for complacency; indeed, it may be cause for alarm. If accounting policies have the effect of obscuring results to the extent that understanding and interpretation become difficult even for analysts, this raises questions about financial reporting in general.

We do not have specific suggestions about ways to remedy this unfortunate situation. Standard-setters would have a hard time developing standards that removed all barriers to interpretation, because issues involving full and clear disclosure are often nebulous and difficult to address. One is tempted to state that the problem lies in attitudes. Attitude adjustment is difficult even in the best of times, and doubly difficult when stress levels are high because of company difficulties. Perhaps the Philips situation must remain only a case study in the way in which barriers to interpretation can arise. But an understanding of how this occurs in a particular case may help us to cope with the more general problem of preventing their erection in the first place.

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Book Reviews

Management Buy-ins: Entrepreneurship, Active Investors and Corporate Restructuring. *Ken Robbie and Mike Wright.* Manchester University Press (Studies in Finance Series), February 1996. xi + 168 pp. £40 h/b.

This is an excellent research monograph. It examines the theory and empirical findings relating to a relatively new (at least for the UK) form of corporate restructuring: the management buy-in (MBI). Using their unique and very impressive Centre for Management Buy-out Research (CMBOR) quantitative datasets, supplemented by surveys of venture capitalists' attitudes, MBI entrepreneurs, detailed case studies of individual MBI transactions and post-MBI performance, Robbie and Wright provide a wealth of interesting material, which makes an important contribution to the academic literature on corporate restructuring. The book should also prove invaluable for the researcher or student interested in the economics of organisation, entrepreneurship and financial contracting generally.

Briefly, an MBI involves not merely a change in a company's ownership, as in the case of a management buy-out (MBO), but also the replacement of the existing top management team with a new team of owner-managers, all or most of whom were previously outsiders. Of course, radical changes in both ownership and management are also characteristics shared by many conventional takeovers and acquisitions. However, an MBI differs from a conventional takeover, because the corporate entity that usually emerges from an MBI transaction is an independent, unquoted business, whose equity capital is held in some combination by the new management team, venture capital organisations and other 'active investors' involved in the deal.

Chapters 1 and 2 are devoted to discussions of the main participants in MBI deals, the characteristics of various types of corporate restructuring, the distinctive theoretical issues and contracting problems associated with MBI transactions, and the development of an institutional framework in the UK during the 1980s that was conducive to such activities.

Are MBI and other forms of corporate restructuring evidence of the operation of an efficient market for corporate control? In principle, yes, provided it results in companies being owned and managed by those best able to achieve high economic returns from the resources under their control. Like takeovers, the economic basis of an MBI transaction stems from a belief that it is possible for a team of outside entrepreneurs to cost-effectively identify individual businesses whose performance can be significantly improved on under a new owner-manager regime. In principle, this makes it feasible for an MBI team to assemble a bid which, though greater than the value of the business to its current owners (and which, therefore, has a high probability of being accepted), is able to attract financial backing from venture capitalists.

The main problem with MBIs is that, even after bearing the search, evaluation and contracting costs associated with identifying and closing deals with suitable MBI targets, outside bidders may still know less about the state of the business than its current owner-managers. Hence, given the upfront search and evaluation costs and the inevitable (pre and post-contract) asymmetric information problems for investors (detailed in Chapter 3), a high degree of entrepreneurial 'optimism' (detailed in Chapter 4) regarding future prospects would appear to be a prerequisite for developing an MBI market.

Robbie and Wright argue that the UK's economic boom, and the development of its financial and legal institutions during the 1980s, created an optimistic outlook, a supply of potential targets, and an entrepreneurial culture that generated a pool of suitable outside management teams, serial entrepreneurs and willing equity investors. Several years down the line, it is apparent that the majority of MBIs have proved to be fairly successful, and a number have generated exceptionally high returns to their investors, many of whom have subsequently exited via trade sales, flotation or refinancing (Chapter 5).

However, in a significant number of cases (see Chapters 5 to 7), the incoming management team, its advisers and financial backers, appear to have seriously over-estimated the possible post-MBI gains and/or under-estimated the costs associated with restructuring the business to achieve the anticipated performance improvements. The sharp reversal in the UK economy after 1989 also appears to have played a large part in falsifying the optimistic assumptions on which many of these deals were based.

The case studies detailed in Chapter 7 of post-MBI failure, particularly those deals completed near the top of the economic cycle, indicate a remarkable lack of pre-contract 'due diligence' checks on the target, a reliance on optimistic projections of new business, and the assumption that additional financial requirements would be limited and/or be easily available.

The concluding chapter draws out some of the implications of these findings for investors and entrepreneurs, many of whom will no doubt be wishing that this text had been available prior to embarking on their MBI adventures.

University of Leeds Robert Watson

Proceedings of the Conference: Accounting and Economics. *Martin Shubik (ed.).* Garland Publishing, 1995. vii + 198.

This volume contains the 16 papers read at a 1992 conference, hosted by a Siena bank, to mark the approaching 500th anniversary of Pacioli's book.

The title raises high hopes: 'Accounting and Economics' recalls, for example, Hicks' immense contribution to our understanding of income and value. But, alas, the hopes soon evaporate. Hicks' interest in a field akin to accounting was not shared by the conference participants. Many of their papers no doubt have merit; but none of them gives much help to the accountant.

The first paper is, very properly, a tribute to Pacioli. It tells of his wanderings and his collaboration with such great men as Leonardo (who for a time shared the same house) and Piero Della Francesca. It describes the ferment caused by the new number system ('the Arabian miracle'). It tells how the youth of the time was taught to use this system, with the aid of many 'masters of abacus' (dextrous with checkers and the chessboard) and a flood of textbooks. Pacioli shared the revived enthusiasm for mathematics; his 25-page appendix on double entry, in a book with 600 pages on mathematics, is only one expression of 'the beautiful Platonic assumption of unity through multiplicity, and multiplicity through unity'.

Two of the papers are by accountants. One (by Professor Burton of Columbia) discusses the half trillion dollar losses by US financial institutions between 1985 and 1995, and the consequent shift from historical cost towards 'fair values'; he discusses too the new problems caused by derivatives. The other, by Professor Ijiri of Carnegie Mellon, sets forth his system of triple entry, and gives us comfort by enlarging on the beauties of double entry; like the problems of Japanese chess, beauty here depends on three things—difficulty, efficiency and originality.

Two useful papers deal with bank accounts. Professor Onado (Bologna) quotes with relish the English banker who, at the turn of the century, announced 'not only do the figures in the balance sheet show you the true position, but the real position is a little better still'. Since then, pressure for use of current values has grown; but there seems to be an unfillable gap between 'economic accounting, logically forward-looking, and practical accounting, necessarily backward-looking'. Practical bankers stress that historical costs makes for stability, and that there is no market—and therefore no current market value—for many of a bank's assets. R.L. Slighton, of the Chase Manhattan Bank, contrasts 'fair value' and liquidation value, and adds that the task of finding fair values would be 'monumental and costly'.

The economists who wrote the rest of the papers were somewhat at a loss for relevant matter. They touch on such topics as frictional unemployment and the limitations of general equilibrium theory. Then, with obvious relief, most of them seize on national accounting. They tell of the able men, from William Petty onwards, who invented and developed it, and they describe the many conceptual and practical difficulties of producing satisfactory figures. They ignore business accounting.

A mistitled and disappointing book.

London School of Economics W.T. Baxter

Economic Influences on the Development of Accounting in Firms. *George J. Staubus.* Garland Publishing, 1996. viii + 166pp. $40.

In this book George Staubus seeks to set forth 'what it is', essentially, that determines the nature of accounting information that firms fashion (a) for management's internal use, and (b) for presentation to outsiders—especially owners. In thoughtful and erudite fashion he draws on the history of economic and accounting thought (up to 1940 — for Staubus, advances in both thought and practice since that time have been of little significance (pp. 147–148) in developing his thesis, which is primarily concerned with (a) 'what is', not with (b) 'what could be', nor, on the basis of (a) and (b) perhaps, (c) 'what ought to be'.

The essential problem for Staubus is set forth in Chapter 1. The chapter first summarises eight different 'general views' about the nature of the business firm (a contracting relationship [Jensen and Meckling], a set of economic relationships [Coase], a governance structure [Williamson], or an entity dominated by economic considerations involving assets, production and pricing). The reader gets a little lost in determining exactly what the eight separate views about the firm are in going through nine sub-heads, the contents of which are, for the most part, unrelated to the eight views. He goes on to define the business firm:

> 'A firm is an *economic unit* directed by one manager or management team that acquires

> resources from other units and combines them to produce one or more products that are sold to other economic units in order *to create wealth*. Firms are also observed to possess other features: each is unique, holds and divides resources, integrates multiple activities, and is ultimately controlled by residual equityholders' (emphasis mine) (p. 17).

And he then proceeds to suggest what it is that essentially dominates the fashioning of an individual firm's accounting practices:

> 'The firm's accounting practices are *controlled by management*, subject to only modest external constraints. Thus, *internal accounting practices* are *designed to meet management's information needs* related to decision-making (including control-oriented decisions). *External reporting practices are tailored to serve management's interests by conveying the desired images to reportees*, subject to constraints imposed by those reportees, regulators, and the events being reported' (emphasis mine) (p.18).

Within this context Staubus, in the third and final section of the Chapter 1 introduction, sets forth nine considerations that he sees as 'influencing' management in its task of determining the nature of accounting information provided on the one hand to insiders, and on the other hand to outsiders. The nine influences center on (a) the differing nature of different firms, which may lead to differing accounting choices—involving two influences of the nine; (b) the objectives, control exercised and possible bias in management choices—involving three influences of the nine; and (c) the needs of other 'constituents' (essentially owners, as Staubus views matters)—involving four influences of the nine.

The heart of Staubus's effort then follows in Chapters 2–4 as he seeks to develop the 'influences' that he sees as determining the fashioning of a firm's accounting data briefly set forth in the Introductory Chapter 1. Chapter 2 discusses 'Tier I influences (Underlying Conditions Influencing the Establishment of Accounting Practices)'. Chapter 3 discusses 'Tier II Influences (Derivative Conditions Influencing the Establishment of Accounting practices)'. Chapter 4 discusses 'The Role of Conflicts of Interest'. But while Chapters 2 and 3 often develop interesting thoughts on differing economic considerations surrounding different firms, which presumably *might* have considerable bearing on the type of accounting information desired, and Chapters 5–6 extend discussion of some of these conditions, Staubus is not interested in 'what can, or could be', but rather only in 'what is'. Hence little is done to suggest ways in which accounting information concerning external economies and diseconomies, for example, might be developed to provide useful information for those concerned with environmental issues, or issues concerning costs and benefits involving different points in time, or perhaps different generations or different groups of people in the same generation. But beyond the 'What is' versus 'What can be' difficulty, it really turns out, after the reader has read Chapter 4 on 'Conflicts of Interest', that the materials of Chapters 2–3 and 5–6 are largely irrelevant even for 'What is'.

Essentially, according to Staubus in Chapter 4, managers' economic/political/psychological self-interest tends to dominate the collection and sharing of a firm's accounting information in the real world, modified to a limited extent by owners' self-interest. The uniqueness of individual firms, differing production techniques and procedures, information and increasing cost problems with growing complexities in organisation, indivisibilities, asset uniqueness and/or non-redeployability—all such considerations involving the modern business firm—end up having little bearing on the outcome with respect to *existing* accounting information...unless they can be tied to managers' self-interest, and to a lesser extent owners'. And while Staubus does not stress the possibility that short-run self-interest may in the case of some of the above-type economic considerations run counter to long-run self-interest, he at least acknowledges this possibility, albeit not dwelling on how and why things might work out this way, nor on what the consequences might be if they did.

Not surprisingly, then, the largely short-run self-interest of managers, modified slightly by owner interests, prevails with respect to existing accounting information, i.e. 'What is'. In Chapter 7, 'Valueless Accounting: Why?', we are told that:

> 'In practice the "old measurement" solution is most generally accepted, with some modest exceptions. Many believe it is justified by conservatism. At this point, one might reasonably ask: Do the explanations for current accounting practices provided in this book support the old-measurements solution? If not, a long shadow is cast over the value of these explanations, or "influences shaping the development of accounting in firms" ' (p.119).

'Valueless accounting', we are told, does indeed fit the Staubus explanation[s] for current accounting practice:

> 'But with historical cost accounting, instead of reporting those [*realised* holding] gains on a separate line where they would be visible to all readers, who might attribute them to exogenous influences, holding gains are not isolated; they reduce cost of goods sold and

> depreciation, so readers are unable to "pull them out" and treat them as exogenous. Historical cost accounting has a liberal effect on the calculation of operating profit. Managements would be foolish to discard that advantage. Valueless accounting is far preferable to value accounting.
>
> 'In sum, valueless accounting is of great assistance to managements as they seek their goal of reporting steadily rising earnings' (p. 124).

Such data are even 'reliable', we are told, in that they are 'verifiable' (i.e. if simple rules are followed consistently...like grading student papers where last names start with A–E an A, those starting with F–J a B, etc), and 'neutral' (in that the simple arbitrary rules are followed and so are 'unbiased'). While Staubus does not discuss 'reliability' in terms of 'representational faithfulness' (in the sense that they might objectively be pictured as describing 'economic reality'), no doubt he would be prepared to argue that, consistent with the FASB definition of 'representational faithfulness' (which is 'correspondence or agreement between a measure or description and the phenomenon it purports to represent'), historical cost/nominal dollar data are indeed 'representationally faithful'.

There is a lot in this book that is worthwhile —very much worth reading—whether one comes to George Staubus's conclusion that there are rational reasons to support the status quo in accounting today, or not. Unfortunately, the book is basically a collection of essays, rather than an integrated, well-organised support of the Staubus position. But that does not mean that the Staubus ideas are not worth puzzling through. Albeit I end up being something of a critic, I have learned a lot in the process of reading through this book!

Hernando, Florida Philip W. Bell

Modern Management Accounting *S. P. Deshpande.* New Age International Limited, 1966. 168pp.

This book provides a comprehensive treatment of cost calculation in a setting of certainty and linear cost expressions, along with reciprocal interdependencies. It offers insight into the sheer size and complexity of costing in a manufacturing environment, a subject we tend to ignore. It also connects the accrual-based costing measurement to working capital measurement—another subject we tend to ignore.

The advantage of the treatment is its consistency; a unified approach to cost calculation is stressed. This provides an element of coherence that is lacking when one approaches the subject in a more ad hoc fashion. The price paid for this appearance of consistency is the use of certainty and linear cost expressions.

More importantly, the subject's treatment is devoid of economic grounding, aside from intuitive connections and the general observation that one begins the exercise with exogenous cost pools, allocation bases and technological coefficients. Consistent links to decision-making, or for that matter the technology and factor price- based analysis of economic theory, are absent. For example, with the emphasis on certainty and linear structures, a natural bridge to economic resource allocation, via linear programming, is possible yet not developed. To be sure, some connections are made, as in the concern over working capital issues in an investment analysis. On balance, though, the study emphasises calculation as opposed to economic analysis and measurement.

University of Florida Joel Demski

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Papers should be in English and consist of original unpublished work not currently being considered for publication elsewhere. They should be typed and double-spaced. *Four* copies should be submitted, together with a submission fee of £18 for subscribers or £36 for non-subscribers. In order to ensure an anonymous review, authors should not identify themselves, directly or indirectly. Experience has shown that papers that have already benefited from critical comment from colleagues at seminars or at conferences have a much better chance of acceptance. Where the research takes the form of field surveys or experiments, *four* copies of the instrument should be submitted. Where the paper shares data with another paper, *four* copies of the other paper must also be provided.

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Watts, R. L. and Zimmerman, J. L. (1986). *Positive Accounting Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Style and spelling

Abbreviations of institutional names should be written as, for example, FASB and not F.A.S.B; those of Latin terms should contain stops (thus i.e. not ie). Words such as 'realise' should be spelled with an 's' not a 'z'. Single quotations marks should be used, not double.

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The Estimation of Monetary Gains and Losses in Diverse International Economic Environments

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Abstract—This study provides empirical evidence about the accuracy of the shortcut techniques for estimating monetary gains and losses sanctioned by the UK and US standard-setting bodies. Our analysis is based on a sample of 300 firms diversified across 30 countries and three levels of inflation. We conclude that shortcut estimation techniques perform poorly, producing average errors five to 10 times as large as estimates based on the more sophisticated methodology of numerical mathematics. These results hold regardless of the rate of inflation incurred or the monetary base used. When judged relative to a revenue-based materiality measure, the economic significance of these errors is substantial in international economic environments exhibiting the highest levels of inflation, and may also be material for a subset of firms that operate in countries with intermediate and lower levels of inflation.

Introduction

Financial statements published in Brazil, Israel and Mexico, among others, are required to include information about the reporting entity's monetary gains and losses. In addition, the disclosure of monetary gains and losses is recommended by the International Accounting Standards Committee (IASC, 1990), the European Economic Community, and in Canada, South Africa, the UK and the US (Coopers & Lybrand International, 1991).[1]

Monetary gains and losses arise as a result of holding monetary assets and/or liabilities during a period of changing prices. In theory, the gain or loss is computed by determining the firm's monetary position and the rate of inflation every time there is a movement in the price index. In practice, of course, price indices are available on a periodic basis only, and it would seldom be possible for a firm to determine its monetary position on the almost continuous basis implied by an exact calculation of the gain or loss (Cagan, 1956, p. 78; Hodgson and Tippett, 1984, p. 47). Because of this constraint, standard-setting bodies, such as the UK Accounting Standards Committee (ASC) and the US Financial Accounting Standards Board (FASB), have sanctioned the use of shortcut estimation techniques (ASC, 1980a,b; FASB, 1979 and 1986).

To date, however, the accounting research literature has provided little guidance in identifying the circumstances under which it might be appropriate to apply such shortcut estimation techniques. This study provides empirical evidence on the accuracy of these techniques relative to some alternative methods based on the numerical mathematics estimation literature (Carnahan, Luther and Wilkes, 1969). Also, in recognition that the rate of price change and the definition of net monetary position vary internationally, we examine whether, and to what extent, observed results depend on the environment in which a firm operates. We address this issue by basing our empirical analysis on six alternative definitions of the monetary base and three levels of changing prices, obtained from a wide cross-section of international economic environments.

Our results indicate that shortcut techniques perform poorly. In our sample of 300 firms diversified across 30 countries, shortcut methods yield average errors five to 10 times as large as estimates provided by the more sophisticated techniques

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[1] Statement of Financial Accounting Standards (SFAS) No. 107 of the Financial Accounting Standards Board (FASB, 1991) requires all entities to disclose the fair value of their financial instruments, whether recognised or not recognised in the financial statements. The Statement is effective for fiscal years ending after 15 December 1992. For entities with less than \$150m in total assets, the effective date is delayed for three years, although earlier application is encouraged.

based on numerical estimation theory. These results hold regardless of the definition of monetary position adopted or the rate of price change incurred. When judged relative to a revenue-based materiality measure, the economic significance of these errors is substantial in economic environments exhibiting the highest levels of changing prices, and may also be material for firms operating in countries with intermediate and lower rates of inflation. These results contribute to the accounting literature in at least two ways. First, the findings are relevant to improving financial reporting of the effects of changing prices on financial assets and liabilities. Second, the more refined estimation techniques analysed in our study may facilitate the formulation of enhanced valuation models in accounting, economics and finance research.

The remaining sections of the paper are organised as follows. The first summarises the shortcut methods sanctioned by the ASC and the FASB, and presents a number of alternative estimation techniques based on numerical estimation theory. The next section presents the data and methods used for calculating monetary gains and losses under the various techniques. The third section presents the results of our study, while policy implications and conclusions are presented in the final section.

Alternative estimation techniques from numerical estimation theory

Tippett (1982 and 1987) has shown that the gain or loss from holding monetary items over the arbitrary time interval [0, 1] is given by the integral expression.

$$MGL = I(1)\int_0^1 \frac{m(t)}{I(t)}\frac{dI(t)}{I(t)}, \qquad (1)$$

where I(t) is the value of a relevant price index, m(t) is the level of monetary holdings, and dI(t) is the instantaneous change in the price index, all at time t. In practice, equation (1) is difficult to operationalise because price changes and the monetary base are unlikely to be measured on a continuous basis. However, numerical estimation theory provides a number of approximating techniques which can be applied, once a limited amount of information is available. Each approximating technique is based on a unique set of assumptions about the time series properties of the price index [I(t)] and the monetary base [m(t)]. The following discussion constitutes a summary of the techniques that have been suggested in the literature (Tippett, 1982; Hodgson and Tippett, 1984; Tippett 1987).

Technique No. 1

Suppose we assume that the opening holding of monetary items [m(0)] is held from the beginning of the period until time **a**, $0 \leq \mathbf{a} < 1$. The ending monetary position [m(1)] is assumed to be held from time **a** until the end of the period. These assumptions imply that the firm's monetary position may be represented in terms of the following step function:

$$m(t) = \begin{cases} m(0) \text{ if } 0 \leq t < \mathbf{a} \\ m(1) \text{ if } \mathbf{a} \leq t \leq 1 \end{cases} \qquad (2)$$

Substituting this expression into equation (1) implies that the gain or loss from holding monetary items is given by:

$$M\hat{G}L_1 = m(0)I(1)\int_0^a \frac{dI(t)}{[I(t)]^2} + m(1)I(1)\int_a^1 \frac{dI(t)}{[I(t)]^2}. \qquad (3)$$

Integrating equation (3) and a little algebraic manipulation yields the estimating rule:

$$M\hat{G}L_1 = \left[\frac{I(1)}{I(0)} - 1\right]m(0) + \left[\frac{I(1)}{I(a)} - 1\right][m(1) - m(0)], \qquad (4)$$

where I(0) is the value of the price index at the beginning of the period and I(1) is its value at the end of the period. If we think of the interval [0, 1] as a year and set a = 1/2, so that I(**a**) is the estimated value of the price index at mid-year, or alternatively, its average value over the year, then equation (4) gives the approximation technique suggested in the British inflation accounting standard SSAP No. 16 (ASC, 1980b, p. 144). In Table 1, we illustrate the ASC method using the computational example provided in ASC (1980b). With the background data presented in Panel A of Table 1, the ASC method yields a monetary loss of £592,418.

Appropriate substitution into equation (4) also yields an estimated gain of £592,418, or:

$$M\hat{G}L_1 = \left[\frac{201.3}{176.4} - 1\right][4{,}000{,}000] + \left[\frac{201.3}{190.7} - 1\right]$$
$$[4{,}500{,}000 - 4{,}000{,}000] = £592{,}418$$

Hence, technique No. 1 and the shortcut method illustrated in ASC (1980b), yield identical results. It also warrants emphasising that the method for calculating the monetary gain or loss recommended by SFAS No. 33 (FASB 1979, para. 232) and SFAS No. 89 (FASB, 1986, para. 66) is very similar to the ASC technique.

To summarise, technique No. 1 is consistent with the shortcut methods suggested by the UK and US standard-setting bodies. This technique has the advantage of being computationally simple

Table 1
SSAP No. 16 Example Calculation of Monetary Gain or Loss[1]

Panel A: Background data

Date	*Index value*	*Net monetary position*
1.1.80	176.4	£4,000,000 (Liability)
31.12.80	201.3	£4,500,000 (Liability)
Mid-year	190.7	

Panel B: Calculation of monetary gain

Net monetary position	*Nominal pounds*	×	*Conversion factor*	*End of year 1980 pounds*
Balance, 1 January 1980	(4,000,000)		$\frac{201.3}{176.4}$	(£4,564,626)
Increase during 1980[2]	(500,000)		$\frac{201.3}{190.7}$	527,792)
Balance, 31 December 1980	(4,500,000)			(£5,092,418)
				(£4,500,000)
			Monetary gain	(£592,418)

[1] Adapted from ASC (1980b, p. 144)
[2] Assumed to occur evenly throughout 1980

and requires a very limited amount of information. Significant weaknesses, however, include the unrealistic assumptions that the firm's monetary position changes only once during the period, and that price changes occur evenly throughout the year. In the following sections, we examine techniques that incorporate more realistic assumptions about changes in the firm's monetary position, and which also allow for alternative assumptions about the rate of inflation through time.

Technique No. 2

The shortcut technique considered above assumes that the firm's monetary holdings change only at one point during the year. For large corporations this is undoubtedly an unrealistic assumption, and we are confronted with the question of how sensitive the estimated inflation gains or losses are to violations of it. One way of checking this is to use estimating techniques that make alternative assumptions about the time series behaviour of both the firm's monetary position and the price index. If the computed gains and losses are insensitive to these alternative assumptions, it strengthens our confidence in the accuracy of the underlying estimating technique.

As an illustration, suppose we assume that the firm's monetary base and the price index itself are linear functions of time. This implies the following approximation of the firm's monetary position:

$$m(t) = m(0) + [m(1) - m(0)]t, \tag{5}$$

where, as previously, m(0) is the firm's holding of monetary items at the beginning of the period and m(1) is the monetary position at the end of the period. Similarly, for the price index we have:

$$I(t) = I(0) + [I(1) - I(0)]t, \tag{6}$$

where I(0) and I(1) are the values of the price index at the beginning and end of the period, respectively. Substituting these functions into equation (1) and evaluating the integral shows the estimated monetary gain or loss to be (Tippett, 1987, pp. 81–82):

$$M\hat{G}L_2 = \frac{I(1)[m(1) - m(0)]}{[I(1) - I(0)]} \log\left[\frac{I(1)}{I(0)}\right] + \frac{m(0)I(1) - m(1)I(0)}{I(0)}. \tag{7}$$

This technique uses data from the beginning and end of the period only, and assumes that the instantaneous change in the firm's monetary position and the price index are both constant through time (Tippett, 1987, pp. 81–82). In theory, it is possible to improve this technique by assuming that the functions m(t) and I(t) are quadratic, cubic or even higher order polynomial functions of time. However, Tippett (1987, pp. 82–84) demonstrates that this quickly leads to intractable integral expressions, so it is not practicable to pursue this approach further. This limitation is unfortunate because the Weierstrass Approximation Theorem shows that polynomial functions can be used to approximate both the price index and the firm's monetary position to any desired degree of accuracy (Carnahan, Luther and Wilkes, 1969, p. 3). We can overcome this problem, however, by utilising an alternative approach, first suggested by Hodgson and Tippett (1984), which simplifies the mathematics and at the same time, allows the use of higher order polynomial approximating techniques.

Technique No. 3

We begin by noting that equation (1) may be re-expressed as:

$$MGL = \mathrm{I}(1) \int_0^1 \mathrm{h(t)\ dI(t)}, \qquad (8)$$

where $h(t) = \frac{m(t)}{[I(t)]^2}$. Under this formulation, the estimated gain or loss from holding monetary items depends on the functions h(t) and I(t).[2] Unfortunately, we can never be sure about the precise form these functions might take; however, the Weierstrass Theorem shows that both I(t) and h(t) can be approximated to any desired degree of accuracy by some polynomial function of time. In general, this means that accuracy will improve with the degree of the fitted polynomial.[3]

To illustrate the approach, suppose we have information about the price index and the firm's monetary holdings at the beginning and end of the period only. Approximating h(t) and I(t) by linear polynomials and using equation (8) implies that the gain or loss from holding monetary items amounts to:

$$M\hat{G}L_3 = \tfrac{1}{2}\left[\frac{\mathrm{m(0)I(1)}}{\mathrm{I(0)}} + \frac{\mathrm{m(1)I(0)}}{\mathrm{I(1)}}\right]\left[\frac{\mathrm{I(1)-I(0)}}{\mathrm{I(0)}}\right]. \qquad (9)$$

The main problem with this and previous approaches, however, is that estimates are based on 'annual' data only and, as such, ignore the potential impact of seasonalities in either the monetary base [m(t)] or the price index [I(t)]. In the following sections we outline some techniques that use more than annual data and therefore are capable of taking account of such seasonalities.

Technique No. 4

This technique uses data from the beginning, midpoint and end of the year, thereby approximating h(t) and I(t) as quadratic functions of time. Tippett (1987, pp. 84–85) shows that this leads to a formula where the estimated monetary gain or loss is a weighted average of the two half-yearly inflation rates, namely:

$$M\hat{G}L_4 = \omega_1\left[\frac{\mathrm{I(1/2)-I(0)}}{\mathrm{I(0)}}\right] + \omega_2\left[\frac{\mathrm{I(1)-I(1/2)}}{\mathrm{I(1/2)}}\right], \qquad (10)$$

where the weights are:

$$\omega_1 = \frac{1}{6}\,\frac{\mathrm{I(1)}}{\mathrm{I(1/2)}}\left[\frac{\mathrm{3m(0)I(1/2)}}{\mathrm{I(0)}} + \frac{\mathrm{4m(1/2)I(0)}}{\mathrm{I(1/2)}} - \frac{\mathrm{m(1)I(1/2)I(0)}}{\mathrm{I^2(1)}}\right],$$

and

$$\omega_2 = \frac{1}{6}\left[\frac{\mathrm{3m(1)I(1/2)}}{\mathrm{I(1)}} + \frac{\mathrm{4m(1/2)I(1)}}{\mathrm{I(1/2)}} - \frac{\mathrm{m(0)I(1/2)I(1)}}{\mathrm{I^2(0)}}\right].$$

Since this technique is based on quadratic approximation, which incorporates linear estimation as a special case, and since it also uses more information than any of the previous techniques, it should provide improved estimates of the monetary gain or loss.

Technique No. 5

One of the more sophisticated techniques suggested in the literature involves using fourth degree interpolating polynomials to approximate h(t) and the price index, I(t). Tippett (1987, pp. 84–85) shows that this leads to a formula where the estimated monetary gain or loss is a weighted average of the four quarterly inflation rates, namely:

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[2] An anonymous referee notes that equation (1) has the alternative form $-I(1)\int_0^1 m(t)d[1/I(t)]$. If we use this expression and approximate m(t) and $1/I(t)$ as nth degree interpolating polynomials, it may be shown that the quadrature formulae take an additive separable form in m(t) and I(t). While such formulae have pedagogical advantages over those presented in the text, our empirical work indicates that they produce estimated monetary losses that are almost identical to those presented in the text. Our view is, however, that the pedagogical convenience implied by such formulae means that this does represent a potentially fruitful area for future research.

[3] It can be shown that any piecewise smooth function may be approximated by a uniformly convergent power series expansion on a normed metric space. Hence, given a polynomial basis appropriate to the norm used, quadratic approximation will be more accurate than linear approximation. Cubic approximation will be more accurate than quadratic approximation, and so on. See Elliot (1979), Jacques and Judd (1987, pp. 180–198) and Tippett (1987) for further details.

$$M\hat{G}L_5 = \omega_1\left[\frac{\mathrm{I}(1/4)-\mathrm{I}(0)}{\mathrm{I}(0)}\right] + \omega_2\left[\frac{\mathrm{I}(1/2)-\mathrm{I}(1/4)}{\mathrm{I}(1/4)}\right] +$$

$$\omega_3\left[\frac{\mathrm{I}(3/4)-\mathrm{I}(1/2)}{\mathrm{I}(1/2)}\right] + \omega_4\left[\frac{\mathrm{I}(1)-\mathrm{I}(3/4)}{\mathrm{I}(3/4)}\right]. \qquad (11)$$

The expressions for the weights, ω_1, ω_2, ω_3 and ω_4, are not presented due to space constraints. Interested readers should refer to Tippett (1987, pp. 87–88).

Since fourth degree polynomials incorporate lower degree polynomials as a special case, this technique should provide more accurate estimates of monetary gains or losses than any of the techniques outlined above. However, a word of caution is in order here: increasing orders of interpolation are often accompanied by highly oscillatory approximating functions, especially near the end points. When this is the case, interpolating polynomials can provide poor approximations to the underlying function and therefore, poor estimates of the gain or loss from holding monetary items (Jacques and Judd 1987, pp. 135–136). Fortunately, there are at least two approaches that might be used to overcome this problem. Probably the easiest is to divide the data into subsets and then to use low order interpolating techniques on each subset. Low order techniques usually provide a relatively smooth fit to the data, and so it is this rationale that underlies the next two estimating techniques. Alternatively, we can opt for one of the more commonly used methods in actuarial science; namely, the fitting of curves that satisfy certain minimum curvature properties. Here, the cubic spline of Schoenberg (1946) is probably the most widely used, and so the final two techniques demonstrate its application to the problem of estimating monetary gains or losses.

Technique No. 6

The simplest way of ensuring that interpolating techniques provide a relatively smooth approximation to the underlying data is to use the method of 'interval halving' (Carnahan, Luther and Wilkes, 1969, pp. 90–91). To illustrate this technique, suppose a firm possesses quarterly information on both its monetary position and the price index. Over the jth quarter, it uses the following piecewise linear approximation for estimating the gain or loss from holding monetary items:

$$\mathrm{m}(t) = \mathrm{m}\left(\frac{j-1}{4}\right) + \left[m\left(\frac{j}{4}\right) - m\left(\frac{j-1}{4}\right)\right](4t+1-j), \qquad (12)$$

for $\left(\frac{j-1}{4}\right) \le t \le \left(\frac{j}{4}\right)$, j = 1, 2, 3, 4. Similarly, the price index is approximated by the following piecewise linear function:

$$I(t) = I\left(\frac{j-1}{4}\right) + \left[I\left(\frac{j}{4}\right) - I\left(\frac{j-1}{4}\right)\right](4t+1-j), \qquad (13)$$

for $\left(\frac{j-1}{4}\right) \le t \le \left(\frac{j}{4}\right)$. Substituting these functions into equation (1) and evaluating the integral gives the following estimate for the gain or loss from holding monetary items (Tippett, 1987, p.84):

$$M\hat{G}L_6 = \mathrm{I}(1)\sum_{\mathrm{j}=1}^{4}\left(\left[\frac{\mathrm{m}(\frac{\mathrm{j}}{4})-\mathrm{m}(\frac{\mathrm{j}-1}{4})}{\mathrm{I}(\frac{\mathrm{j}}{4})-\mathrm{I}(\frac{\mathrm{j}-1}{4})}\right]\log\left[\frac{\mathrm{I}(\frac{\mathrm{j}}{4})}{\mathrm{I}(\frac{\mathrm{j}-1}{4})}\right] - \left[\frac{\mathrm{m}(\frac{\mathrm{j}}{4})}{\mathrm{I}(\frac{\mathrm{j}}{4})} - \frac{\mathrm{m}(\frac{\mathrm{j}-1}{4})}{\mathrm{I}(\frac{\mathrm{j}-1}{4})}\right]\right) \qquad (14)$$

This is the simplest form of piecewise approximation, and involves joining a set of data by a sequence of straight lines to approximate the underlying functions. Hence, under this regime, the method outlined in technique No. 2 is successively applied to the quarterly monetary and price index data. Restating each quarterly estimate to end of period currency, and adding, gives the above formula.

Technique No. 7

This technique uses the method of 'interval halving' and quadratic approximation to the underlying functions. Hence, suppose we have quarterly data and we approximate the firm's monetary position and the price index by quadratic functions on the two semiannual periods making up the year. Tippett (1987, pp. 84–85) shows that this leads to an estimating formula which is a weighted average of the quarterly inflation rates, namely:

$$M\hat{G}L_7 = \omega_1\left[\frac{I(1/4)-I(0)}{I(0)}\right] + \omega_2\left[\frac{I(1/2)-I(1/4)}{I(1/4)}\right] + \omega_3\left[\frac{I(3/4)-I(1/2)}{I(1/2)}\right] + \omega_4\left[\frac{I(1)-I(3/4)}{I(3/4)}\right], \qquad (15)$$

where the weights, ω_1, ω_2, ω_3, and ω_4, are:

$$\omega_1 = \frac{1}{6}\,\frac{I(1)}{I(1/4)}\left[\frac{3m(0)I(1/4)}{I(0)} + \frac{4m(1/4)I(0)}{I(1/4)} - \frac{m(1/2)I(1/4)I(0)}{I^2(1/2)}\right],$$

$$\omega_2 = \frac{1}{6}\,\frac{I(1)}{I(1/2)}\left[\frac{3m(1/2)I(1/4)}{I(1/2)} + \frac{4m(1/4)I(1/2)}{I(1/4)} - \frac{m(0)I(1/2)I(1/4)}{I^2(0)}\right],$$

$$\omega_3 = \frac{1}{6}\,\frac{I(1)}{I(3/4)}\left[\frac{3m(1/2)I(3/4)}{I(1/2)} + \frac{4m(3/4)I(1/2)}{I(3/4)} - \frac{m(1)I(3/4)I(1/2)}{I^2(1)}\right],$$

and

$$\omega_4 = \frac{1}{6}\left[\frac{3m(1)I(3/4)}{I(1)} + \frac{4m(3/4)I(1)}{I(3/4)} - \frac{m(1/2)I(1)I(3/4)}{I^2(1/2)}\right].$$

In effect, this method is based on technique No. 4. Beginning, quarterly and half-yearly data are used to provide an estimate of the monetary loss for the first half of the year. Similar procedures are then applied to the data for the second half of the year. The estimate for the first half of the year is then translated into end of year currency and added to the estimate obtained for the second half of the year to give the overall estimate, as specified by equation (15).

Technique No. 8

The last two techniques are based on the cubic interpolating spline. Spline methods owe their origin to Schoenberg (1946, p. 45), who noted that in '. . . actuarial mathematics it is at times desirable to compute very smooth approximations to empirical data . . .'. Subsequently, Holloday (Ahlberg, Nilson and Walsh, 1967, p. 3) confirmed Schoenberg's intuition by proving that the cubic interpolating spline provides the 'smoothest' possible fit to a given set of data. To illustrate the technique, suppose we have semi-annual information about the price index and the firm's holding of monetary items. Tippett (1987, pp. 86–88) shows that the estimated gain or loss can then be computed as a weighted average of the firm's real monetary position over the year, namely:

$$M\hat{G}L_8 = I(1)\left(\frac{V_1}{96}\log\left[\frac{I(1)}{I(0)}\right] + \omega_1\frac{m(0)}{I(0)} + \omega_2\frac{m(1/2)}{I(1/2)} + \omega_3\frac{m(1)}{I(1)}\right), \qquad (16)$$

$$\omega_1 = \tfrac{1}{2}\log\left[\frac{I(1/2)}{I(0)}\right] - \frac{L_1}{32},$$

$$\omega_2 = \tfrac{1}{2}\log\left[\frac{I(1)}{I(0)}\right],$$

$$\omega_3 = \tfrac{1}{2}\log\left[\frac{I(1)}{I(1/2)}\right] + \frac{L_1}{32},$$

$$L_1 = 6\Delta^2\log[I(0)] = 6\,\{\log[I(1)] - 2\log[I(1/2)] + \log[I(0)]\}, \text{ and}$$

$$V_1 = 6\Delta^2 R(0) = 6\left[\frac{m(1)}{I(1)} - 2\frac{m(1/2)}{I(1/2)} + \frac{m(0)}{I(0)}\right],$$

where $\Delta^2(\cdot)$ is Newton's forward difference operator (Carnahan, Luther and Wilkes, 1969, p. 35). If there is reason to believe that both the price index and the firm's monetary position are smooth functions of time, then this technique is to be preferred over previous methods.

Technique No. 9

The previous technique uses interpolating splines in conjunction with semi-annual data to estimate the gain or loss from holding monetary items. The method can also be applied to quarterly data. When this is the case, Tippett (1987, pp. 86–88) shows that the estimated gain or loss is computed as a weighted average of the firm's real monetary position over the year:

$$M\hat{G}L_9 = I(1)\left[k + \omega_1\frac{m(0)}{I(0)} + \omega_2\frac{m(1/4)}{I(1/4)} + \omega_3\frac{m(1/2)}{I(1/2)} + \omega_4\frac{m(3/4)}{I(3/4)} + \omega_5\frac{m(1)}{I(1)}\right]. \qquad (17)$$

The expressions for k and the weights ω_1, ω_2, ω_3

and ω_4 and ω_5 are not presented due to space constraints. Interested readers can refer to Tippett (1987, pp. 87–88).

Cubic spline approximation used in conjunction with quarterly data represents the most sophisticated methodology so far suggested in the literature. We conclude this section by providing a detailed summary in Table 2 of the mathematical assumptions that underlie each of the nine techniques examined in the present study.

Methodology

Criterion Measure, Study Design and Error Metric

An obvious way of assessing the accuracy of a given approximating technique is to compare its estimates of the gain or loss with the actual figure as defined by equation (1). As previously noted, however, the actual figure cannot be determined without completely specifying the monetary base [m(t)] and the price index [I(t)]. Since these functions are defined in continuous time, firms would seldom produce the information necessary for an exact evaluation of equation (1). Hence, we used the estimated monetary gain or loss obtained from technique No. 9 ($M\hat{G}L_9$) as the principal criterion measure.

There are several reasons for favouring technique No. 9 as a criterion. First, it is one of only two techniques based on the cubic spline. As noted earlier, cubic splines provide the smoothest possible approximation to a given set of data, and they always converge to the underlying function as the number of data points increases; a property not always shared by the other methods considered in this study.[4] Further, while technique No. 8 also employs spline methodology, technique No. 9 was deemed superior because it uses five data points rather than the three used by technique No. 8. It should, as a consequence, provide better approximations to the actual gain or loss.

Our empirical analysis was based on data for 300 firms operating in 30 countries. These firms were grouped into equal sized tripartitions based on the inflation rates of their respective countries. While our principal intent was to assess the accuracy of the shortcut technique sanctioned by the UK and US standard-setting bodies, we also appraised the seven other estimating techniques referred to above, relative to technique No. 9.[5] Further, the monetary gain or loss was computed using six alternative definitions of the monetary base. Hence, our testing procedures were based on an 8 (techniques) × 6 (monetary definitions) × 3 (inflation groups) full factorial design (Scheffe, 1959, pp. 119–124). More detailed information about the sample of companies and alternative definitions of the monetary base used in our study are provided below.

The error metric utilised in the study was:

$$\epsilon_{i,jkl} = \left| \frac{M\hat{G}L_{i,jkl} - M\hat{G}L_{9,jkl}}{M\hat{G}L_{9,jkl}} \right|, \tag{18}$$

where:

$\epsilon_{i,jkl}$ = Error for firm (l = 1,2...100), using the ith technique (i = 1,2,4...8), for the jth inflation group (j = 1,2,3), using the kth definition of monetary position (k = 1,2...6).

$M\hat{G}L_{i,jkl}$ = Estimated monetary gain or loss for firm 1, using technique i, in the jth inflation group, applying the kth definition of monetary position.

$M\hat{G}L_{9,jkl}$ = Estimated monetary gain or loss for firm 1, using technique No. 9, in the jth inflation group, applying the kth definition of monetary position.

In calculating the error measure, absolute values were utilised in order to avoid the problem of large positive and negative errors netting out to a small average error, and thus obscuring erratic performance by an estimator.

Alternative Definitions of Net Monetary Position

Calculation of monetary gains and losses requires an explicit definition of the assets and liabilities which should be included in the monetary base [m(t)]. Unfortunately, a great deal of confusion surrounds this issue and so, it is not surprising that a number of definitions have been advanced in the literature. Tweedie (1979), for example, identifies no fewer than six definitions of the monetary base:

1. All current monetary assets (excluding fixed or long-term monetary assets).

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[4] Techniques 3–7 are based on the interpolating techniques derived by Lagrange. In a seminal paper, Runge considered the nth degree Lagrangean approximation, $L_n(f; x)$, to the function $f(x) = 1/(1+25x^2)$ over the interval $-1 < x < 1$. He was able to show that for $|x| > 0.7266\_\_$, $L_n(f; x)$ diverged from the actual values as n increased. See Elliott (1979) for a detailed technical discussion of this issue.

[5] In addition to testing the accuracy of the shortcut technique, we tested the accuracy of the seven other techniques for the following reason. As Table 2 demonstrates, the other techniques vary in their assumptions, data requirements and complexity. In seeking to expand our knowledge of how to accurately estimate monetary gains and losses, it seems appropriate to explore whether and to what extent using different data sets, modelling assumptions and computations of varying complexity affect the accuracy of the estimation process.

Table 2
Summary Description of Mathematical Assumptions Underlying Each Estimation Technique

Technique number	*Monetary position and price index data points needed*	*Numerical function used to approximate the relationship between m(t), h(t), or r(t) and time (t)*	*Numerical function used to approximate the relationship between the price index I(t) and time*
Shortcut			
1	2-Beginning $(t=0)$ and ending $(t=1)$	Step function - Constant balance from beginning to mid-period; Constant balance after mid-period to end of period.	No specific function is assumed. Mid-period index is assumed to be the average of beginning and ending index values
Linear function			
2	2-Beginning $(t=0)$ and ending $(t=1)$	Net monetary position m(t) is modelled as a linear function of time.	The price index I(t) is modelled as a linear function of time.
Polynomial functions			
3	2-Beginning $(t=0)$ and ending $(t=1)$.	The function $h(t)=m(t)/I(t)^2$ is modelled as a first degree polynomial.	The relationship between the price index I(t) and time is modelled as a first degree polynomial.
4	3-Beginning $(t=0)$, mid-period $(t=1/2)$, and ending $(t=1)$.	The function $h(t)=m(t)/I(t)^2$ is modelled as a second degree polynomial	The relationship between the price index I(t) and time is modelled as a second degree polynomial.
5	5-Beginning $(t=0)$, and end of four sub-periods $(t=1/4, 1/2, 3/4$ and $1)$.	The function $h(t)=m(t)/I(t)^2$ is modelled as a fourth degree polynomial.	The relationship between the price index I(t) and time is modelled as a fourth degree polynomial.
6	5-Beginning $(t=0)$ and end of four sub-periods $(t=1/4, 1/2, 3/4$ and $1)$.	Within each of four sub-periods, the function $h(t)=m(t)/I(t)^2$ is modelled as a first degree polynomial.	Within each of the four sub-periods, the relationship between the price index I(t) and time is modelled as a first degree polynomial.
7	5-Beginning, middle and end of each two sub-periods $(t=0, 1/4, 1/2, 3/4$ and $1)$.	Within each of two sub-periods, the function $h(t)=m(t)/I(t)^2$ is modelled as a second degree polynomial.	Within each of two sub-periods, the relationship between the price index I(t) and time is modelled as a second degree polynomial.
Cubic spline functions			
8	3-Beginning $(t=0)$, mid-period $(t=1/2)$ and ending $(t=1)$.	The function $r(t)=m(t)/I(t)$ is modelled as a cubic spline.	The relationship between log I(t) and time is modelled as a cubic spline.
9	5-Beginning $(t=0)$ and end of four sub-periods $(t=1/4, 1/2, 3/4$ and $1)$.	The function $r(t)=m(t)/I(t)$ is modelled as a cubic spline.	The relationship between log I(t) and time is modelled as a cubic spline.

Note: $m(t)$ = nominal net monetary holdings at time t.
$I(t)$ = the price index value at time t.
$h(t)=m(t)/[I(t)]^2$.
$r(t)=m(t)/I(t)$

2. All monetary assets (current and non-current).
3. All monetary assets less current liabilities.
4. All monetary assets (excluding cash) less creditors.
5. Net monetary items or, equivalently, all monetary assets less all monetary liabilities.
6. All monetary assets less all liabilities.

In practice, definition No. 3 is recommended by the UK standard, SSAP 16 (ASC, 1980b, p. 133), and definition No. 5 is utilised by the US standards, SFAS 33 and SFAS 89 (FASB, 1979 and 1986). However, our empirical testing procedures were applied using each of the above six definitions.

Financial Data

Financial data for our study were obtained from the 1984 to 1991 editions of *Moody's International Manual*. These manuals provide annual balance sheet and profit and loss statement data for over 5,000 firms operating in over 100 countries. We selected the four-year time period from 1984 to 1988 in order to simulate the quarterly presentation of data as required by several of our estimation techniques[6], and also to approximate a normal economic cycle (Sherman, 1991). Selection procedures began by identifying all countries represented in *Moody's* for which data on 10 or more firms were available for the period covered by our study. From this field, 30 countries were selected in order to encompass economic environments exhibiting a wide range of inflation rates. After these 30 countries were identified, 10 firms from each country were randomly selected for inclusion in the study. These procedures resulted in a final sample of 300 firms (30 countries × 10 firms in each country), and five data points (1984–1988) on each firm for a total of 1,500 firm-year observations. For each firm, we collected details of the monetary position necessary to implement each of the six definitions discussed in the preceding section.

Alternative Levels of Price Change

As described in the previous subsection, our sample consisted of 10 firms from each of 30 countries. The experimental design required that the firms be classified into tripartitions based on the inflation rates of their respective countries. The first of these was the 'highest' inflation group and was composed of firms from Australia, Brazil, Hong Kong, Israel, Mexico, New Zealand, Norway, Pakistan, South Africa and Spain. Cumulative inflation over the four years covered by the study for this group ranged from approximately 30% to a hyperinflationary rate of just over 15,000%[7] with a median (average) inflation rate of 50% (1,759%). The second group consisted of firms from Canada, Denmark, Finland, Italy, Philippines, South Korea, Sweden, Thailand, the UK and the US. Cumulative inflation for this 'intermediate' group of countries ranged from about 14% to 24% with a median (average) inflation rate of 19% (19%). The final tripartition consisted of the 'lowest' inflation group of countries and was composed of Austria, Belgium, France, Germany, Japan, Luxembourg, Malaysia, Netherlands, Singapore and Switzerland. Cumulative inflation for this group ranged from zero to 12% with a median (average) inflation rate of 4% (5%).

Method of Analysis

The original plan was to analyse the data as a three-way repeated measures fixed effects Analysis of Variance (ANOVA) (Scheffe, 1959, p. 6). However, initial testing disclosed that variances across inflation groups were heterogeneous, and we were unable to stabilise them using any of the standard transformations (Kendall and Stuart, 1966, pp. 114–115; Scheffe, 1959, pp. 83–87). Fortunately, Scheffe (1959, p. 341) and Neter, Wasserman and Kuner (1990, p. 624) have shown that conducting one-way ANOVAs for each possible combination of the six definitions of monetary position and three alternative inflation groups results in F tests which are relatively robust with respect to heterogeneous variances. The primary disadvantage of this testing procedure is that the experimentwise type-I (alpha error) may be increased (Freund and Walpole, 1987, pp. 387–391; Scheffe, 1959, p. 343). However, as noted in the following section, each of the 18 one-way ANOVA tests yielded very small observed significance levels (OSLs). Hence, the potential for alpha error would appear to be minimal.

After the estimated monetary gains and losses were calculated for all 300 firms, we compared the data against an algorithm designed to examine the internal consistency of the estimation techniques. This checking procedure disclosed that estimates derived from technique No. 3 ($M\hat{G}L_3$) would, on occasion, compute a gain (or loss) in circumstances when theory suggested a loss (or gain) was realised. None of the other eight techniques exhibited this deficiency. As a result of this reliability problem, we excluded technique No. 3 from further analysis.

Results

Highest Inflation Countries

Average error (ε) values for each combination of estimation technique and definition of monetary position are given in Panel A of Table 3. Results were highly variable, with error metrics ranging from a high of 1.23 or 123% to a low of 0.03 or

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[6] The use of data from four years to simulate quarterly data was necessitated by the lack of published quarterly data for firms operating in a wide variety of international economic environments. Since changes in monetary position are likely to be greater over a four-year period than over a one-year period, there was some concern that results of the study might overstate the errors produced by the shortcut methods for computing monetary gains and losses. However, since the error metric used in the study is an error rate rather than an absolute measure [see equation (18) which defines ε], and since the materiality measure was based on total revenue over the four-year period [see equation (19)], we do not think the use of annual data to simulate quarterly data resulted in a significant overstatement of the errors produced by the shortcut methods. This was confirmed by simulations conducted by the authors.

[7] The classification was based on price change data obtained from the International Labour Office (1991). The data were in the form of general price indices which constitute broad-based consumer price indices for each country. It is also worth noting that the IASC (1990) defines hyperinflation as approximately 26% or more a year (ICAI, 1981; Goldschmidt, 1992).

3%. For the monetary bases endorsed by the UK (definition No. 3) and US (definition No. 5) standard-setting bodies, the shortcut estimating technique No. 1 performed poorly. The error metric for monetary definition No. 3 amounted to 76%, while definition No. 5 returned an average error of 46%. In contrast, estimating technique No. 6 yielded average errors of 9% and 7%, respectively, for the two monetary definitions.

For each of the six definitions of the monetary base, a one-way ANOVA was performed to test whether the observed differences in average error values across the seven estimation techniques were statistically different. For each of the six F-tests, the observed significance level was 0.0001.[8] A multiple comparison test was also performed to determine which estimation techniques yielded average values that were statistically less than the values provided by the shortcut estimating technique No. 1 (SAS, 1990, p. 947). As disclosed in Table 3, technique No. 6 yielded a smaller average value in all cases. In many cases, techniques No. 5 and No. 7 also yielded smaller average error values than technique No. 1.

In summary, these results suggest that the shortcut techniques sanctioned by SSAP 16, SFAS 33, and SFAS 89 have the potential to yield very large estimation errors for firms that operate in the highest inflation environments. For such firms, shortcut methods such as technique No. 1 or variants on it, may result in significant errors.[9]

Intermediate and Lowest Inflation Countries

Panels B and C of Table 3 present average error values for firms operating in the intermediate and lowest inflation countries. These results are similar to those reported in Panel A for the highest inflation countries. In each case, the ANOVA F-values are statistically significant with observed significance levels of 0.0001.[10] Also, multiple comparison procedures disclosed that, in all cases, estimating techniques No. 6 and No. 7 produced smaller average error values than the shortcut technique No. 1 (SAS, 1990, p. 947).[11]

For the time period studied, both the UK and the US were classified in the intermediate inflation group. For this group, the third definition of the monetary base (ASC, 1980a,b) and the shortcut estimating technique No. 1 returned an average error of 96%, while technique No. 6 yielded an average error of 11%. For the fifth definition of the monetary base (FASB, 1979), estimating technique No. 1 returned an average error of 42%, while technique No. 6 yielded an average error of 4%. Hence, in both these comparisons, technique No. 6 provided error reductions of approximately 90% when compared with the shortcut technique No. 1. Recall that technique No. 6 uses the maximum of five data points and models h(t) and I(t) as linear functions within each quarter. It has long been known that piecewise linear approximations perform well when the spacing between observations is small and the function being approximated is relatively 'smooth' (Kloeden and Platen, 1992, p. 296). This would appear to be the underlying rationale for the relative good performance of estimating technique No. 6.

Economic Significance of Monetary Gain or Loss

To assess the potential economic significance of estimated monetary gains and losses, we calculated the ratio of the absolute value of the monetary gain or loss to price level adjusted revenue for each firm. Revenue was used as a standardising measure to help judge the materiality of the calculated gains and losses because it has been shown to be significantly correlated with the materiality judgments of auditors (Boatsman and Robertson, 1974). Also, Pany and Wheeler (1989) found that revenue-based materiality measures are more stable than other measures, such as profitability or total assets. As with previous analysis, absolute values

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[8] Similar results were obtained from a series of six one-way non-parametric ANOVAs using the Friedman test (Conover, 1980, p. 299).

[9] As noted by a reviewer, one obvious weakness of technique No. 1 is its reliance on data from a small number of sub-periods. To investigate the improvement in technique No. 1 results that might accrue when using more subperiods, we performed a supplementary analysis in which technique No. 1 was modified to use quarterly data like techniques Nos. 5, 6 and 7. Using the UK and US definitions of monetary position, respectively, the average ε values for the modified version of technique No. 1 were 0.61 and 0.40 for the highest inflation countries; 0.72 and 0.26 for the intermediate inflation countries; and 0.53 and 0.65 for the lowest inflation countries. When compared to data presented in Table 3, these results demonstrate that using data from additional sub-periods reduced average estimation error (ε), but the performance of the modified version of technique No. 1 still lagged behind that of techniques Nos. 5, 6 and 7.

[10] Similar results were obtained from a series of one-way non-parametric ANOVAs using the Friedman test (Conover, 1980, p. 299).

[11] As previously noted, our experimental design required that firms be classified into tripartitions based on the inflation rates of their respective countries. The 10 countries comprising the 'lowest inflation' group had accumulated inflation of 0%, 1%, 3%, 4%, 4%, 4%, 7%, 8%, 9% and 12% respectively. However, annual inflation rates in excess of 4% would not normally be regarded as 'low' and so, this raises the issue of how representative this sample of 10 companies might be of 'true low inflation' countries. We attempted to address this issue by computing average ε values for the six countries with accumulated inflation rates of 4% or less. Surprisingly, these six countries had average ε values that were slightly higher than those for the 'lowest inflation group' as a whole. Hence, for monetary items definition No. 3, the shortcut technique returned an average ε over the six countries of 1.15, compared to 0.90 for the full sample. For monetary items definition No. 5, the average ε value was 1.52 compared to 1.17 for the sample as a whole. These and subsequently reported figures would seem to support the hypothesis that our 'low inflation group' does adequately represent low inflation countries.

Table 3
Average ε Values and Statistical Tests of Comparison across Estimation Techniques

Inflation group	*Definition of monetary position*	*Average ε for estimation techniques indicated*[1] *1*	*2*	*4*	*5*	*6*	*7*	*8*	*ANOVA F-test OSL*[2]	*Techniques with average ε values statistically smaller than shortcut technique*[3]
Panel A										
Highest	1	0.24	0.20	0.40	0.11	0.03	0.09	0.11	0.0001	5,6,7,8
Highest	2	0.23	0.20	0.40	0.10	0.03	0.09	0.11	0.0001	5,6,7,8
Highest	3 (UK)	0.76	0.86	0.95	0.20	0.09	0.18	0.49	0.0001	5,6,7
Highest	4	0.94	1.22	1.23	0.30	0.10	0.28	0.71	0.0001	6
Highest	5 (US)	0.46	0.60	0.77	0.25	0.07	0.15	0.33	0.0001	6,7
Highest	6	0.38	0.44	0.67	0.15	0.05	0.12	0.26	0.0001	5,6,7
Panel B										
Intermediate	1	0.16	0.16	0.09	0.02	0.01	0.01	0.09	0.0001	4,5,6,7,8
Intermediate	2	0.14	0.14	0.08	0.02	0.01	0.01	0.08	0.0001	4,5,6,7,8
Intermediate	3 (UK)	0.96	0.97	1.08	0.27	0.11	0.13	1.00	0.0001	5,6,7
Intermediate	4	0.64	0.67	0.80	0.18	0.09	0.09	0.76	0.0001	6,7
Intermediate	5 (US)	0.42	0.43	0.34	0.08	0.04	0.04	0.31	0.0001	5,6,7
Intermediate	6	0.63	0.65	0.54	0.13	0.05	0.07	0.51	0.0001	5,6,7
Panel C										
Lowest	1	0.14	0.14	0.12	0.03	0.02	0.01	0.11	0.0001	5,6,7
Lowest	2	0.14	0.14	0.11	0.03	0.02	0.01	0.10	0.0001	5,6,7
Lowest	3 (UK)	0.90	0.91	0.52	0.17	0.11	0.05	0.49	0.0001	4,5,6,7,8
Lowest	4	0.99	1.00	0.76	0.18	0.12	0.05	0.71	0.0001	5,6,7
Lowest	5 (US)	1.17	1.18	0.83	0.21	0.16	0.05	0.78	0.0001	5,6,7
Lowest	6	1.05	1.06	0.67	0.17	0.12	0.05	0.63	0.0001	5,6,7

[1] Technique 3 was deleted due to reliability problems, and technique 9 was utilised as the criterion variable in calculating ε.
[2] Null hypothesis is that average ε values do not differ across estimation techniques.
[3] REGWQ multiple comparison procedure was used with an α level=0.05 (see SAS, 1990, p. 947).

Table 4
Ratio of Absolute Monetary Gain or Loss to Price Level Adjusted Revenue Using Estimation Technique 9

Definition of monetary position	*Inflation group*			*ANOVA F-test OSL*[1]	*Inflation groups' ratios statistically larger than the lowest inflation group ratio*[2]
	Highest	*Intermediate*	*Lowest*		
1	0.10	0.09	0.06	0.0904	None
2	0.15	0.11	0.08	0.0226	Highest
3 (UK)	0.06	0.05	0.01	0.0007	Highest, intermediate
4	0.07	0.04	0.02	0.0006	Highest
5 (US)	0.13	0.03	0.01	0.0001	Highest
6	0.16	0.04	0.01	0.0001	Highest

[1] Null hypothesis is that ratios do not differ across inflation groups.
[2] REGWQ multiple comparison was used with an α level $= 0.05$ (see SAS, 1990, p. 947)

were used to avoid the potential problem of large positive and negative values netting out to a small average ratio. The estimated gain or loss from applying technique No. 9 was used as the basis for calculating the materiality ratio.

Formally, the materiality measure was:

$$\mathrm{Ratio}_{9,\mathrm{j,k,l}} = \frac{|M\hat{G}L_{9,\mathrm{j,k,l}}|}{\sum_{\mathrm{n}=1}^{4} \mathrm{R}_{\mathrm{n,l}} \left\{ \mathrm{I}(1)/[\mathrm{I}(\frac{\mathrm{n}}{4})\ \mathrm{I}(\frac{\mathrm{n}-1}{4})]^{\frac{1}{2}} \right\}}, \qquad (19)$$

where:

$\mathrm{Ratio}_{9,\mathrm{j,k,l}}$ = Ratio for firm 1(1 = 1,2. . .100), using approximation technique No. 9, for the j^th^ inflation group (j = 1,2,3), using the k^th^ definition of monetary position (k = 1,2. . .6),

$|M\hat{G}L_{9,\mathrm{j,k,l}}|$ = Absolute value of the estimated monetary gain or loss for firm 1, using technique No. 9, in the j^th^ inflation group, applying the k^th^ definition of monetary position,

$\mathrm{R}_{\mathrm{n,l}}$ = Total revenue for firm 1 in period n (n = 1,2,3,4),

I(1) = Price index at the end of the period, and

$\mathrm{I}(\frac{\mathrm{n}}{4})$ = Price index at the end of period n.

Table 4 provides information on the average materiality measure for each inflation group. For the highest inflation group, the average absolute gain or loss ranged from 6% to 16% of price level adjusted revenue, depending on the monetary base adopted. For monetary definitions No. 3 and No. 5 the ratios were 6% and 13% respectively. These ratios suggest that the gain or loss is potentially significant. For the intermediate and lowest inflation groups, the ratios were somewhat smaller. The third monetary base, for example, returned a materiality ratio of 5% for the intermediate inflation group and 1% in the lowest inflation group. For definition No. 5 the ratios were 3% and 1%, respectively. However, even these values appear to possess economic significance in light of the discussion in Pany and Wheeler (1989, p. 72), which suggests that amounts in excess of one-half of 1% of revenue might be considered material.[12]

To test whether these ratios varied across inflation groups, a one-way ANOVA was performed for each of the six alternative definitions of the monetary base. Test results, provided in Table 4, indicate that differences do exist across inflation groups for all but the first definition of the monetary base. Ratios for the highest inflation group were all statistically larger than ratios for the lowest inflation group. With the exception of gains and losses calculated using the third monetary base, however, materiality ratios from the intermediate inflation group did not differ from ratios from the lowest inflation group.

Economic Significance of the Error Produced by the Shortcut Method

Data presented earlier suggest that monetary gains and losses are economically significant in countries experiencing the highest inflation rates,

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[12] The average ratio of the absolute monetary gain or loss to price level adjusted revenue for the six low inflation countries with accumulated inflation of 4% or less were 0.04 for monetary items definition No. 1, 0.05 for definition No. 2, 0.01 for definition No. 4, 0.005 for definitions Nos. 3 and 6 and 0.003 for definition No. 5. While these ratios are somewhat lower than those reported in Table 4 for the low inflation group as a whole, only the ratio for definition No. 5 does not satisfy the Pany and Wheeler (1989) materiality criterion. The significance of this, of course, is that monetary items definition No. 5 is the one used in the US, and so our results could be interpreted as reinforcing the view that monetary gains and losses, on average, may not be material in low inflation environments.

Table 5
Shortcut Estimation Technique 1 Compared to Estimation Technique 9: Average δ Values Across Inflation Groups

Definition of monetary position	*Inflation group*						*ANOVA F-test OSL*[1]
	Highest		*Intermediate*		*Lowest*		
	δ	ρ	δ	ρ	δ	ρ	
1	0.0359	0.51	0.0087	0.30	0.0048	0.25	0.0001
2	0.0547	0.49	0.0095	0.29	0.0046	0.25	0.0001
3(UK)	0.0279	0.46	0.0078	0.28	0.0027	0.16	0.0010
4	0.0279	0.44	0.0075	0.28	0.0041	0.14	0.0025
5(US)	0.0489	0.55	0.0054	0.27	0.0024	0.13	0.0003
6	0.0602	0.58	0.0061	0.28	0.0026	0.16	0.0001

δ-The average unsigned difference ($M\hat{G}L_{1,j,k,l}$ - $M\hat{G}L_{9,j,k,l}$), divided by price level adjusted revenue. Differences equal to or exceeding one-half percent (0.005) of price level adjusted revenue are considered potentially material.

ρ-The proportion of firms where the difference ($M\hat{G}L_{1,j,k,l}$ - $M\hat{G}L_{9,j,k,l}$) equals or exceeds one-half percent (0.005) of price level adjusted revenue.

1-Null hypothesis is that δ values do not differ across inflation groups.

and have the potential to be economically significant in countries experiencing intermediate and lower inflation rates. Given these results, it seems reasonable to examine whether the error produced by using the shortcut estimation technique is also significant.

To address this issue we calculated a second error measure, *δ*, the unsigned difference between the estimates derived from techniques 1 and 9, and standardised this difference using price level adjusted revenue. Table 5 presents the average results of this calculation for each inflation group. In the highest inflation group, *δ* ranged from a high of 5% to a low of 2.79%. All of these values exceed one-half percent of revenue, and thus appear to be potentially material. In the intermediate inflation group, *δ* ranged from 0.95% to 0.54%, with all of these values also potentially material. For the lowest inflation group, the *δ* values ranged from 0.48% to 0.24%; all less than one-half percent of revenue. ANOVA F-tests disclosed that, for each alternative definition of monetary position, average *δ* values varied across inflation groups.[13] Hence, for our sample, the magnitude of the error increased as the inflation rate increased.

While information regarding the average *δ* value is useful, materiality judgments are made at the firm-specific level. Hence, it would be helpful to know the extent to which use of the shortcut technique produced potentially material errors at the firm-specific level. To address this issue, Table 5 reports a value *ρ*, which represents the percentage of firms where the difference between the estimates derived from techniques No. 1 and No. 9 equalled or exceeded one-half percent of price level adjusted revenue. As Table 5 discloses, the values of *ρ* ranged from 58% to 44% in the highest inflation group, from 30% to 27% in the intermediate inflation group, and from 25% to 13% in the lowest inflation group. Thus, the use of technique No. 1 produced potentially material errors in approximately: (1) 50% of the firms in the highest inflation group; (2) 30% of the firms in the intermediate inflation group; (3) 20% of the firms in the lowest inflation group.[14] All of these percentages appear to be non-trivial, thus suggesting that, regardless of the inflation group, care should be exercised in deciding when use of the shortcut technique is appropriate.

Policy implications and conclusions

Financial statements published in Brazil, Israel and Mexico are required to include presentations of monetary gains and losses. Also, disclosure of monetary gains and losses is recommended by the International Accounting Standards Committee (IASC, 1990), the European Economic Community, and in Canada, South Africa, the UK, and the US (Coopers & Lybrand International, 1991). Although these disclosures appear to be relevant to financial reporting in diverse international economic environments, the estimation of monetary gains and losses is an area in which little academic research has been conducted. Hence, relevant accounting standards have been designed and implemented without the benefit of the empirical analysis which might justify the use of one estimating technique over another. The present paper attempts to address this issue by assessing the accuracy of the ASC (1980a,b) and the FASB (1979 and 1986) shortcut techniques relative to the more sophisticated techniques of numerical mathematics.

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[13] For the six low inflation countries with accumulated inflation of 4% or less, average *δ* values varied from 0.0017 for definition No. 5 to 0.0041 for definition No. 1. The average *δ* value for definition No. 3 was 0.0021.

[14] For the six low inflation countries with accumulated inflation of 4% or less, *ρ* varied from 0.1 for monetary items definition No. 5 to 0.20 for definitions Nos. 1 and 2. Definition No. 3 returned a value of $\rho = 0.12$.

Our results indicate that the shortcut techniques perform poorly, often yielding average errors five to 10 times larger than those incurred by more sophisticated techniques. These results hold regardless of the inflation group or the monetary base adopted. When judged relative to a revenue-based materiality measure, the economic significance of these errors is substantial in international economic environments exhibiting the highest levels of inflation, and may also be material for a non-trivial percentage of firms operating in countries with intermediate and lower rates of inflation. Hence, the ASC and FASB should develop more precise guidelines to help firms judge when use of the shortcut technique is appropriate.

The recent research of Hall and Shriver (1990), Lim and Sunder (1990 and 1991) and Rhys, Tippett and Tahir (1993) amongst others has examined the potential impact of measurement errors arising from the effects of changing prices on *non-monetary* assets. Our study complements this prior research by analysing the measurement errors that might arise when computing gains and losses on *monetary* assets and liabilities. As this area forms part of the IASC's (1983 and 1990) ongoing research agenda, our results should also contribute to both the international financial reporting policy and academic research literatures.[15]

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[15] Although the estimation techniques examined in this study are more computationally complex than the shortcut techniques sanctioned by the ASC and the FASB, this increased level of complexity does not appear to present a meaningful barrier to implementation. For example, software products are already available for various option pricing models in compliance with FASB Statement 107 (FASB, 1991). If one or more of the estimation techniques analysed in our study were ultimately adopted for financial reporting purposes, international public accounting firms and valuation consultants would undoubtedly provide their clients with software products such as *Fair Value Analyzer* (Coopers & Lybrand, 1992) to aid in implementation.

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A Corporate View of Research Needs in Corporate Finance

Wilson E. Herbert and R. S. Olusegun Wallace*

Abstract—This paper reports the results of a survey of UK chief financial officers (CFOs) drawn from 72 large, 34 medium and 37 small companies on potentially important research topics in corporate finance. The paper suggests that there are gaps between extant academic research and the CFOs' needs for such research. The topics that the 143 CFOs would like to see on the research agenda include: the influence of tax laws on financial decision-making; investor reactions to companies concentrating on short-term gains to the almost total neglect of long-term benefits; effects of changes to the law on pension funds; cash flow planning and forecasting; regulators' awareness of financial issues; and methods for determining the riskiness of a project. Of least importance to the CFOs are research on the significance of bankruptcy costs, influence of the City on corporate financial operations and impact of seasons on operational decisions. The degree of importance attributed to research topics seems to vary with firm size. In general, the findings of this study are similar to those from a survey of financial managers in the US.

Introduction

Observers of research in finance (such as Carleton, 1978; Cornel and Shapiro, 1987; Baxter, 1988; Cooper and Zeff, 1992) have long been exhorting academics to devote much attention to issues that are close to financial practitioners' needs, because, as Carleton (1978) observes, most contemporary theory and research in corporate finance do not even deal with what in the abstract are its central problems. For example, using research on cost of capital to illustrate an area where there is a gap between theory and practice, Allen (1992) suggests that despite the overwhelming academic literature on the subject, practitioners have remained 'largely sceptical of what they see as abstruse mathematics based on hypotheses far removed from reality and, as a consequence, many have resorted to unsubstantiated quantification or felt unable to express an opinion and withdrawn from the decision-making process'. Thus a major challenge facing financial academics is to bridge this perceived gap. One way of bridging it is to determine financial managers' views on potentially important research issues in corporate finance. Such a survey is needed because (a) practitioners' concerns on the relevance of extant academic research and (b) practitioners' views on research agenda might help to suggest new emphasis and new directions for future corporate finance research (CFR).

The above concerns raise two questions. First, what is the problem with extant CFR? Second, why is CFR not sufficiently addressing important practical problems facing the practitioner? The study, therefore, attempts to raise the consciousness of the reader to the apparent user-supplier gap in CFR and suggests that the underlying philosophy of extant CFR is bereft of *responsive focusing*[1] (Guba and Lincoln, 1989, p. 12). Answer to the first question is provided through the CFO survey. The second question is conceptual and calls for a look at paradigmatic issues of CFR such as drawing implications from CFOs' revealed preferences.

One aim of the survey is to ascertain the attitudes of UK CFOs towards selected corporate finance topics which were investigated in an earlier US study (Ramírez et al; 1991), with a view to determining whether UK CFOs' perceptions of research needs are similar to those of US financial managers. There are reasons for replicating the US study in the UK. Essentially, financial research is important to the future of the world economy—far too important to be limited arbitrarily to the findings of one national study. Different national contexts of CFR help to define the status of education and practice in financial management; they help to identify global finance topics of interest and sup-

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[1] The modifier *responsive* directs attention to the need to focus research on users' needs. The implication of *responsive focusing* for research design is to focus more and more on the claims, concerns and issues that are identified by stakeholders (beneficiaries and users) of research and less on research with little relevance to practice.

port globalisation of finance curricula and practice. They also help build a literature on comparative national studies on finance, which is presently scanty although there is growing literature on comparative national studies in other areas, such as managerial perceptions and corporate practices (Gray et al., 1990); currency risk management (Collier et al., 1990); international financial reporting (Gray et al., 1984; Meek and Saudagaran,1990; and Wallace and Gernon, 1991); and corporate views on international education (Beamish and Calof, 1989).

However, the present study differs from the US study (Ramírez et al., 1991) in the following ways. First, it differs in terms of data collection. The respondents to our survey were CFOs from companies of different sizes (large, medium and small). In contrast, Ramírez et al. surveyed individuals at three different levels of financial managament in each *Fortune 500* company in their sample, whether a company was publicly or privately held. Second, the study sample is based on UK companies, which included some of Europe's largest conglomerate multinationals. All the large and medium-sized companies participate in the over-the-counters (OTC) market. However, notwithstanding the differences in the study samples and data collection, significant differences between the views of UK and US financial managers are not expected because, according to the convergence theory (Ralston et al., 1993), managers in one industrialised nation embrace attitudes and behaviours common to managers in other industrialised nations despite cultural differences. This view of commonality of managerial attitudes and values has been shared by others such as Cooper (1979) and Hofstede (1983).

Another aim of the study is to explore the importance of company characteristics, such as size (as measured by turnover and number of employees), industrial sector, and ownership structure, in shaping CFOs' perceptions of research needs. However, the problem with this type of research is reaching consensus on what is or should be 'relevant' CFR. As shown in the paper, the differential needs of large and small companies would make it a complex task to arrive at an agreed academic CFR agenda and/or re-orientation. Nevertheless, the study does have broad policy implications. For example, it is possible for academic researchers and providers of research funds, such as the Economic and Social Research Council, and professional accounting bodies to recognise that the needs of large companies are in many ways different from those of small companies, and thus seek ways to address the differential needs of large and small companies.

The rest of the paper is divided into four sections. To strengthen the association with subsequent analysis of CFOs' responses to the questionnaire, the relevant trends of exant academic CFR are summarised in the next section. The second section describes the methodology, including details on the data gathered from responses to the questionnaire on CFOs' perceptions. The third section presents the results and general observations, and the fourth section concludes the paper.

Extant academic CFR

The purpose of this section is not to present a historical evolution of CFR but to focus on the usefulness of some current CFR to critical thinking and to practice. Working capital management (WCM) and the three broad, if linked, theoretical issues in corporate finance (cost of capital, capital structure and asset valuation) addressed by Modigliani and Miller (1958, 1963) are used for this purpose. For each broad area, we examine the a priori logic that predates the particular theory in CFR and examine whether theoretical developments in the area are designed to be of service to practice. For this purpose, theory must be descriptive of practice (or correspond to facts). However, as suggested later in this section, the major problem with extant theories of CFR is their lack of verisimilitude.

Working Capital Management

CFR on WCM is characterised by the use of heuristic criteria and the application of developments in operations research and stochastic modelling. Heuristic criteria came in the form of financial ratio tests made popular by credit-rating agencies, and particularly by an 1869 New York court ruling in the case of *Ormerby v. Douglas*, 37 N.Y. 477. The court ruled that a credit report, developed without malice and in good faith and on request, was a 'privileged communication' and thus outside the province of libel (see Beckman, 1924 and Shultz, 1947 for more details). As a result, industry norms for financial ratios, that were not derived analytically, evolved from the cumulative experiences of credit agencies and groups of commercial bankers. The ratios also became the raw materials for academics' prediction (using Z-scores) of corporate failures.

While these financial ratios were evolving, financial economists were busy enunciating the motives for holding money, and chasing the ill-conceived 'liquidity trap'. Viewed against the ill-effects of the Great Depression, this academic quest for resolving the liquidity problem was responsive to the needs of business. Developments in operations research fostered the study of optimal inventory levels. 'Inventory', in this case, is a metaphor for cash, cash equivalents, stock and debtors balances. Mathematical programming enabled the scholars to factor into their analysis of optimality questions on dynamic issues such as the combined resolution of optimal values of stock, cash/bank balances, accounts receivable and accounts payable in the presence of several constraints.

Problems such as the location of warehouses and lockbox banking sites were also tackled. However, academic research on WCM has been and continues to be normatively driven. There is a need for more descriptive work to explain the role and function of the components of working capital. Recent work by Myers (1984) and Myers and Majluf (1984) is an effort in this direction. Myers and Majluf suggest that companies normally finance net present value investment opportunities with 'slack'[2] before resorting to new common stock financing, and that companies tend to build up slack, including its working capital component, because seeking finance through new issues is a negative signal to the market. Corporate slack is one of three great controversies in CFR; the others are dividend and capital structure problems (discussed below). It re-echoes the free-cash-flow hypothesis[3] of Jensen (1986) and is suggested as an indicator of a takeover target.[4] Although similar to the organisational slack concept in the theory of the firm, Myers (1990) has extended the concept of corporate slack (or corporate surplus) to mean the difference between the market value of a company's debt and equities and the present values of the company's earning potential (from its present assets) and growth opportunities, less the present values of tax obligations. Myers' (1990) corporate slack theory suggests the construction of an economic balance sheet for a company, but there are, as is true of many CFR theories, many operational questions unanswered. How and why are the two present values of normal earning potential and growth opportunities of assets decomposed? What would happen in the event of a negative corporate slack? How can one determine the market value of equities and debt that are not freely traded?

Corporate Finance

Prior to Modigliani and Miller's contribution, financial economists vacillated between the use of anecdotes and the net income (NI) or the net operating income (NOI) approaches to make assertions about, rather than to explain or describe, observable company valuation practices. The approaches were loosely held together by the microeconomic principles of short-termism, with emphasis on the distributable fixed costs for the leverage effect. Modigliani and Miller (1958) were the first to offer a theoretical basis for understanding the three interconnected issues of cost of capital, capital structure and valuation. Their framework was hinged on a set of carefully selected and strict (many quite unrealistic) assumptions and a rigorous (arbitrage) proof used to convert the NOI approach from a set of mere assertions to a theory about observable relations in corporate finance. The major conclusion of Modigliani and Miller's theory in its pristine (the set of original assumptions, without taxes) form was that, if there are valuation discrepancies between any two companies in a partial equilibrium framework (i.e. if there is a homogeneous risk class), they emanate from market imperfections. However, Modigliani and Miller's (1958) theory was not descriptive. It excluded or assumed away the distinction between corporate and personal taxation, the positive relation between leverage and the marginal cost of borrowing and the difference between personal and corporate accounts. But their analytical robustness was weakened when they (1963) relaxed some of their unrealistic assumptions.

The basic difference between the Modigliani and Miller theory (after all corrections for taxes) and the traditional financial economists' approaches, after allowing for the concessions for a static versus a dynamic model, was in the placing of financing and investment decisions in order of importance. The traditional financial economists think that financing decision dominates investment decision, whereas Modigliani and Miller contended that investment decision is superior because financing decision is either irrelevant (without taxes) or trivial (with taxes). Because of tax subsidy on debt, their theory would predict an all-debt capital structure. Since this is not truly descriptive, they explain that their theory's lack of verisimilitude was due to the shortcoming of forcing a static model on a dynamic problem. To correct this anomaly, Modigliani and Miller (1963) posited the concept of target debt/equity ratio.

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[2] Corporate slack, in this context, is the holding of 'excess liquidity', which is a metaphor for other slacks (spare capacity, excess inventory, unused credit lines and accounts receivable). Slacks are often encouraged to take care of cashouts, stockouts and customer defaults, which may penalise companies differently.

[3] The underlying rationale of the free-cash-flow hypothesis is that uncommitted cash will be squandered through excessive spending on perquisites or investment in negative net present value projects. As a result, shareholders are advised to purge free cash by demanding high dividends or financing that imposes high fixed payments (interest) on management. However, the hypothesis is based on the assumption that internal and external managerial labour markets and the market for corporate control (takeovers) lack the necessary discipline and are, in effect, inefficient (Fama, 1980; Myers, 1990).

[4] Three other competing theories for explaining takeover activities are synergy, tax factors and market share. The synergy theory is used to explain the quests for potential operating and financing efficiencies that can arise from takeovers. Financial synergies may accrue from altering cash flow streams or the overall debt structure of the combined entity, just as operating synergies such as economies of scale and scope may arise from vertical and horizontal takeovers. Tax factors may motivate takeover activities. For example, a profitable company may acquire a company that has accumulated tax losses which can be used to shelter earnings of the acquiring company. Finally, market share theory suggests that takeover activities exist because companies have a desire to increase market share (size) so as to decrease the number of competitors in the industry.

Essentially, their theory remains normative. All empirical work (Modigliani and Miller's, their supporters' and critics') focused on the estimation of cost of capital, but the theory has not been validated empirically. Instead, Modigliani and Miller theory was modified and refined in two unrelated directions: (1) the construction of a new theory (by Scott, 1977 and Kim, 1978) which dealt with trading off of the benefits of tax subsidy for the risk factored costs of bankruptcy; and (2) the extension of Modigliani and Miller theory from a partial equilibrium to a general equilibrium setting by Hamada (1969, 1972). Each of the two developments is discussed in turn.

Modigliani and Miller did not explain observable traditional gearing ratios: why do all companies not use the tax subsidy to its fullest? Bankruptcy is a potential consequence of any business dealing, even though it is often ignored by financial theorists through the going concern assumption. Attempts to construct a theory of corporate failure (by Stiglitz, 1972; Scott, 1977; and Kim, 1978), that is, to identify and generalise the major causes of failure, have been meagre and generally unsatisfactory because of the complexity and diversity of business operations, the lack of well-defined economic (and behavioural) theories of the firm under uncertainty, and a surprising reluctance by many researchers to incorporate the failure phenomenon in their models (Lev, 1974, p. 134). If one factors into the calculus of financial risk (of increased gearing) the cost and the probability of operational bankruptcy, one is bound to discover an indifference point between the financial benefits of gearing and the potential cost of distress. On one side of the indifference point, the benefits of tax subsidy will outweigh the potential cost of bankruptcy; on the other side, the possibility of financial distress will eliminate the tax advantage. As a result, value-maximising companies will select their capital structure such that they will be at or very near an indifference point. Like the Modigliani and Miller theory it modifies, the trade-off theory offers scholars the advantage of the relative ease of casting its ideas in mathematical terms, and this feature endowed both theories with an aura of exactitude though not practical relevance. For example, the trade-off theory lacks a statistical mechanism that can bind observable costs of bankruptcy with probabilities in a consistent and scientifically acceptable manner.

Despite the lack of mundane realism in Modigliani and Miller theory, Hamada (1969) transformed it from its partial equilibrium setting to a general equilibrium milieu without questioning and modification. The desire for this transformation may be due to general demand by financial economists for theories embedded in general equilibrium, and the criticism that the homogeneous risk-classes which constitute the bedrock of the partial equilibrium setting of the Modigliani and Miller theory cannot be defined. The transformation into the general equilibrium milieu was through the capital asset pricing model (CAPM). The merging of Modigliani and Miller theory that is yet untested to another theory (CAPM) that is not descriptive[5] and empirically not testable (Roll, 1977) would extend rather than narrow the supplier-user gap of CFR theories. As explained later in this paper, the practice of developing universal theories in corporate finance is not descriptive of reality, because corporate behaviour is ordered by categories and usually follows specific risk-class or industrial norms.

Recent re-examination of corporate finance theories have shown concern and explicit recognition of the environment in which companies operate; that is, they have moved from seeing the company as an island to the recognition of the informational asymmetries that exist between insiders and outsiders and the divergence of interests of these groups of real and potential stakeholders in a company. These new developments include the application of signalling models to the explanation of capital structures (Ross, 1977); the use of agency-theory-motivated explanations; and ad hoc scenarios and organisation theory of capital structure. In signalling models, dividends, corporate slack, etc. are seen as signals of the 'true' quality of the company. Signalling theories arise from the notion of the information asymmetry. It is presumed that companies that pay dividend or build up corporate slack are better than companies that do not. However, there may be other means of signalling (such as building a high quality management team) that are less costly than dividends or corporate slack. In addition, signalling theories are incapable of explaining the dynamic aspects of dividends, capital structure or corporate slack.

Methodology

The questionnaire used to elicit opinions from UK CFOs is a slightly modified version of an instrument used by Ramírez et al. (1991) for the US survey.[6] After pre-testing, the questionnaire was mailed to 500 UK companies drawn at random from the 1992 edition of *Key British Enterprises.* The questionnaire was mailed to the selected companies' CFOs with a letter explaining that the questions in each category focused on those specific corporate finance issues where, it is thought, they would require the assistance of more academic research and where they would expect the results of such academic research to contribute to more efficient financial management. Potential respondents were told that a similar survey had been conducted in the US, and that the purpose of the present study was to find out how they perceived the importance of research on these issues, and that the result would be shared with the academic community. The first part of the questionnaire was demographic and sought information about company and industry-specific characteristics, not about the responding CFOs as individuals. The last part of the questionnaire sought the opinions of potential respondents on the level of importance of each of 26 corporate finance research topics to their work as financial managers.

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[5] CAPM is a single-period, non-dynamic, static-equilibrium model. It admits only a limited number of sources of uncertainty and it does not permit the consideration of *uncertain* future interest rates and *uncertain* future market risk parameters, although there have been attempts to incorporate dynamic problems into the model.

In total, 186 companies (37.2%) responded to the questionnaire[7], of which 28.6% (or 143) were usable. Although this usable response rate is better than Ramírez et al.'s, it is still disappointing and raises an interpretational problem. In order to gauge the bias due to non-response, the following evaluations were made: (1) a comparison of late respondents with early respondents, as recommended by Armstrong and Overton (1977), Oppenheim (1966) and Wallace and Mellor (1988); (2) a comparison of the first and second mailings (Wallace and Mellor, 1988), and (3) a comparison of company size of respondents and non-respondents, as suggested by Wallace and Mellor (1988). Where a survey entails two or more mailings, and generates non-usable responses (as is often the case in many postal surveys), it is possible, as was done in this study, to evaluate the discrepancy between a set of observed frequencies and expected frequencies of returns among (i) the first, second, etc. mailings, (ii) usable and non-usable questionnaire returns, and/or (iii) company characteristics. The χ^2 tests revealed no significant differences between either the respondents and non-respondents, the first and second mailings, or usable and non-usable responses.

Where write-in comments can be solicited as follow-ups, they serve to validate respondents' opinions and provide some indication of non-response bias. However, we promised potential respondents that they would not be disturbed with follow-up questions. As a result, it was considered unethical to contact specific CFOs for post-questionnaire clarification that might have enabled us to unravel some of the reasons for late response from the respondents to the second mailing. Consequently, analyses of response bias and reasons for low response are limited.[8]

Data Analyses

Respondent characteristics. In 80% of the cases, the CFO respondents were finance directors. Other CFO respondents were either chief accountants, treasurers or company secretaries. Table 1 presents the characteristics of the responding companies. About 51% of the sample companies have revenues in excess of £100m, and over 43% employ over 1,000 people. The sample covers a wide industrial base, from manufacturing through services to utilities, with a greater percentage belonging to industrial and financial/service sectors.

Aggregation of responses. Respondents were asked to indicate the level of their agreement with perceptual anchors on the level of importance of each of 26 CFR items in the survey instrument, in terms of the relevance of the potential research findings from each item to their corporate financing decisions. The survey instrument was anchored along a five-point Likert scale (varying from 'strongly agree' = 5, to 'strongly disagree' = 1, with room for equivocation in the middle—the anchor 'not sure' = 3; $\alpha = 0.8387$). Although the effects of academic CFR on practice are often not singularly independent, respondents were requested to treat each item as independent of the others and to assign as many '5s', '4s', '3s' etc., as they felt were warranted by the items included in the survey instrument.

We report two inter-rater correlation coefficients (ICCs), which are estimates of reliability and validity. ICC(1) is an estimate of the degree to which respondents within each group responded

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[6] A problem with a replication study is that it usually inherits the limitations of the original study. The Ramírez et al. (1991) study derived the list of finance problems from US literature (textbooks and academic articles): Brealey and Myers (1988), Smith (1990); Black (1976) and Pinegar and Wilbricht (1989). While it may not be appropriate to use American texts in developing CFR topics of interest to UK CFOs, the topics in Ramírez et al. (1991) provide a useful starting point for replication in the UK context, provided it is adapted to reflect the UK environment.

[7] The number of questionnaires received daily by corporate executives accounts for a low response rate in mail surveys. As Collier and Wallace (1992, p. 286) suggest, some companies are simply resorting to a policy of not responding to questionnaires, regardless of their nature. For example, 26 companies returned the questionnaire uncompleted on account of company policy. Thus, this response rate (37.2% from two mailings) is quite positive and compares favourably with most studies.

[8] Perhaps, as a reviewer suggests, the low response rate is due to the belief by most non-respondents that academics cannot help with their research needs.

Table 1
Characteristics of Respondent Companies

Ownership structure	%
Parent companies	46.15
Subsidiaries	51.05
Associates	1.40
Joint ventures	1.40
	100.00

Turnover	%
Under £10m (small companies)	25.87
£10m-£100m (medium companies)	23.78
Over £100m (large companies)	50.35
	100.00

Number of employees	%
Under 50	15.38
51 - 200	18.18
201 - 500	11.19
501 - 1,000	11.89
Over 1,000	43.36
	100.00

Industry classification	%
1. Manufacturing	40.6
2. Construction	4.2
3. Agriculture	0.7
4. Services	25.2
5. Finance and banking	7.7
5. Oil and energy	18.9
6. Trade, retailing, leasing	2.7
	100.0

Intercorrelations of corporate characteristics

	Ownership	*Employees*	*Turnover*	*Industry*
Ownership	1.0000			
Employees	0.2131	1.0000		
Turnover	0.1782	0.8322*	1.0000	
Industry	0.2115	0.1510	0.1027	1.0000

* $p \leqslant 0.01$

similarly, and ICC(2) is an estimate of the reliability of the mean scores.[9]

Results

In order to construct a perceived level of importance of each CFR item, we averaged the re-

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[9] ICC(1) and ICC(2) address two different issues (Ostroff and Schmitt, 1993, p. 1,349). If two respondents were randomly sampled from the same group and their two sets of scores correlate, the resulting correlations would approximately equal ICC(2) which is scaled as zero (0) when the level of agreement is what would be expected to be observed by chance and 1 when there is perfect agreement. For intermediate values, Lan-

Table 2
Intercorrelations, Means and Mean Rankings of the Importance of CFR Topics Compared with US Rankings from Ramirez et al.'s (1991) Study

Intercorrelations of operational finance topics (see Appendix)

	item 1	*item 2*	*item 3*	*item 4*	*item 5*	*item 6*	*item 7*	*mean*	*std. dev.*	*rank*	*(US) rank*
item 1	1.0000							3.01	1.08	25th	19th
item 2	0.2082	1.0000						3.46	0.97	17th	20th
item 3	0.1113	0.1372	1.0000					3.61	0.94	9th	6th
item 4	0.1886	0.1787	0.4637*	1.0000				3.41	1.00	18th	25th
item 5	−0.0000	0.2538*	0.3777*	0.5486*	1.0000			3.52	1.06	13th	23rd
item 6	0.0557	0.1772	0.2943*	0.3270*	0.3361*	1.0000		3.13	0.94	24th	24th
item 7	0.0258	0.1174	0.3058*	0.4691*	0.4340*	0.3787*	1.0000	3.88	1.01	4th	6th

Intercorrelations of regulation topics (see Appendix)

	item 8	*item 9*	*item 10*	*item 11*	*item 12*	*mean*	*std. dev.*	*rank*	*(US) rank*
item 8	1.0000					4.12	0.70	1st	2nd
item 9	0.0652	1.0000				3.31	1.03	22nd	15th
item 10	0.1683	0.4151*	1.0000			3.73	0.87	6th	12th
item 11	0.0602	0.0888	0.3292*	1.0000		3.67	0.87	8th	10th
item 12	0.1078	0.2088	0.1679	0.3128*	1.0000	3.94	0.94	3rd	3rd

Intercorrelations of ownership topics (see Appendix)

	item 13	*item 14*	*item 15*	*item 16*	*item 17*	*item 18*	*item 19*	*mean*	*std. dev.*	*rank*	*(US) rank*
item 13	1.0000							3.35	1.07	20th	20th
item 14	0.3783*	1.0000						3.39	0.98	19th	17th
item 15	0.2889*	0.2320*	1.0000					3.32	0.93	21st	4th
item 16	0.0089	0.1117	0.4378*	1.0000				3.54	1.04	10th	5th
item 17	0.1923	0.1484	0.1206	0.4081*	1.0000			3.50	0.88	15th	13th
item 18	0.1755	0.1068	0.0113	0.2663*	0.2594*	1.0000		3.68	0.93	7th	11th
item 19	0.1884	0.2254*	0.1635	0.2378*	0.2116	0.2036	1.0000	4.08	0.97	2nd	1st

Intercorrelations of long-term financing topics (see Appendix)

	item 20	*item 21*	*item 22*	*item 23*	*item 24*	*item 25*	*item 26*	*mean*	*std. dev.*	*rank*	*(US) rank*
item 20	1.0000							3.81	0.965	5th	13th
item 21	0.6427*	1.0000						3.54	0.88	11th	18th
item 22	0.4799*	0.4962*	1.0000					3.52	0.98	12th	6th
item 23	0.2377*	0.3721*	0.3740*	1.0000				2.96	1.05	26th	26th
item 24	0.1683	0.1958	0.3756*	0.3341*	1.0000			3.51	0.94	14th	9th
item 25	0.1449	0.2387*	0.3114*	0.3687*	0.3969*	1.0000		3.24	0.96	23rd	22nd
item 26	0.0428	0.1580	0.0497	0.3287*	0.2241*	0.4472*	1.0000	3.48	1.08	16th	15th

* $p \leq 0.01$

sponses on each item. Table 2 presents the intercorrelations of perception scores (from the pooled sample), the means and standard deviations of the perception scores and the mean rankings (from this and the US study) on each of the CFR topics investigated. Item 8 (influence of tax laws on financial decision-making) had the highest mean score and was perceived by 89% of the respondents as the most important corporate finance issue in need of further research. The second most important topic is item 19 (investor reactions towards companies concentrating on short-term performance and ignoring long-term benefits). The research importance of this topic is reflected in the high percentage of responses in the agree/strongly agree anchor. From the write-in comments, respondents would want research into the converse of this question, i.e., whether investors 'reward' companies for concentrating on short-term performance while 'penalising' those with long-term focus. Item 12 (effects of pension fund law changes) and item 7 (cash flow planning and forecasting) follow closely and respectively as the third and fourth important research topics. Measures for determining the riskiness of a project (item 20) and the need to draw the attention of CFOs to performance issues of concern to regulators (item 10) were considered deserving of further research.

Item 23 (significance of bankruptcy costs) was generally viewed as being the least important corporate finance research factor, as it was regarded by over 38% of the respondents to be of little relevance. The next least important research item is the influence of the City (item 1). Other research topics perceived to be of little importance are items 6 (seasonality impact of operational decisions), 9 (effects of deregulation of financial services industry), and 25 (value of investment banking as sources of funds). Overall, the results suggest that issues pertaining to regulation are in greater need of research than those relating to operational finance, ownership or long-term finance. Topics relating to regulation include the influence of tax laws on financial decision-making; the effects of pension fund law changes; and regulators' awareness of financial performance issues.

There are small differences between the means from the pooled sample. The largest difference between the highest mean (i.e. the topic that on average came up as the most important—item 8) and the lowest mean (item 23) is 1.16, and a vast majority of the differences between the means for the other items are below 1.0 (see Table 2). Pooled sample analysis panders to the quest of financial economists for general equilibrium theory, but the reality may be that different categories of company and/or different sectors of the economy may perceive corporate finance problems differently, as the ability to come to grips with such problems often differs according to whether a company belongs to one category/sector or the other. To unravel the seeming convergence from the pooled data, we reanalysed the data in two different ways. First, we used the responses showing agreement with the suggestion that a CFR item is important, and those responses disagreeing with the suggestion, to derive an index of agreement. An index of agreement is the ratio of total agreeing responses (i.e. 5s and 4s) over total disagreeing responses (i.e. 1s and 2s). The index excludes equivocal (i.e. 'not sure') responses which vary from item to item. To make the index of agreement comparable, each index was adjusted to reflect the ratio of unequivocal responses to all responses. The adjusted index was computed by multiplying the index of agreement by this ratio. The results of this procedure are reported in Table 3. The variations between the rankings from the index of agreement and the adjusted index of agreement are minimal. The adjusted indexes of agreement also confirm the results reported in Table 2.

Second, the data was disaggregated on the basis of company sizes (turnover) into 72 large, 34 medium, and 37 small companies. Although aggregated (pooled) data analysis suggests that many of the topics warranted more research, significant differences exist between companies of different sizes on the importance of several CFR topics.

Table 4 presents the adjusted indexes of agreement, the mean ratings as well as the results of the χ^2 tests of the difference between the distributions[10] of the three sub-samples arising from the disaggregation on the basis of company size. Item 5 (impact of accounts receivable/payable policies)—the top priority of small companies—does not feature prominently on the ranking based on the pooled mean responses (see Tables 2 and 3). While this issue is regarded as very important by 89% of the responding CFOs from small companies, it is regarded as considerably less important by respondents from large companies. Indeed, the item does

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dis and Koch (1977, p. 165) suggest the following interpretations: below 0.0 = poor agreement; 0.00–0.20 = slight agreement; 0.21–0.40 = fair agreement; 0.41–0.60 = moderate agreement; 0.61–0.80 = substantial agreement; and 0.81–1.00 = almost perfect agreement. ICC(2) ratings of 0.60 and above suggest that one can reject the hypotheses that respondents were scoring an item randomly and that one can conclude that acceptable levels of mean score reliability exist (Nunnally, 1978). ICC(1) indicates the extent to which respondents within the same group assign the same psychological meaning to, or agree in their perceptions of, the relevance of research results on a CFR topic. ICC(1) compares the between sample sum of squares to the total sum of squares from the results of a one-way analysis of variance. In past research, ICC(1) values have ranged from 0 to 0.5, with a median of 0.12 (James, 1982). There are no definite guidelines on acceptable ICC(1) values.

[10] The use of the χ^2 distributions in hypothesis-testing is analogous to the use of the t or the F distributions (Hinkle et al., 1979, p. 336).

Table 3
Pooled Sample Indexes of Agreement on the Level of Importance Accorded CFR Topics (n = 143)

CFR topics	*Index of agreement*	*Rank*	*Adjusted index of agreement*	*Rank*
1. Influence of the City on financial operations	1.0877	25th	0.9052	25th
2. Effect of ownership concentration on operations	3.0000	15th	2.1972	16th
3. Asset-liability management techniques	4.0455	10th	3.1120	10th
4. Values of liquidity (cash holdings)	2.3333	18th	1.8202	19th
5. Impact of accounting policies on receivables and payables	2.6667	16th	2.2723	15th
6. Seasonality impact on operational decisions	1.4359	24th	0.9539	24th
7. Cash flow planning and forecasting	5.3810	7th	5.0425	5th
8. Influence of tax laws	31.7500	1st	29.0862	1st
9. Deregulation of financial services industry	1.8286	22nd	1.2659	23rd
10. Regulators' awareness of performance issues	6.0625	4th	4.7906	6th
11. Effects of financial statement restriction	5.1667	8th	4.0388	8th
12. Effect of pension fund law changes	7.0000	3rd	5.8744	3rd
13. Stock price determination	2.0286	21st	1.5695	20th
14. How dividends are fixed	2.3143	19th	1.9040	18th
15. Cost and value of leveraged buyouts	2.0909	20th	1.5126	21st
16. Management's role in takeover bids	3.7391	12th	2.8903	11th
17. Effect of shareholder concentration on company value	3.7500	11th	2.5448	14th
18. Influence of transmission on analysts and investors	5.7059	5th	4.6132	7th
19. Investors' reaction to short-term performance	8.3846	2nd	7.4925	2nd
20. Project risk measures	5.6316	6th	5.2177	4th
21. Project evaluation measures	3.0345	14th	2.6300	12th
22. Factors in debt/equity choice	3.0714	13th	2.5745	13th
23. Significance of bankruptcy costs	0.7692	26th	0.5204	26th
24. Use of new securities to reduce financial risk	4.2632	9th	3.1577	9th
25. Value of investment banking services	1.8286	22nd	1.4118	22nd
26. Effect of pension funds on firm valuation	2.6207	17th	2.0234	17th

not feature in the list of the top 15 CFR topics. In addition, items 6 (the impact of seasons on operational decisions) and 8 (influence of tax) received no dissenting votes from the medium companies in the sample. Of the responding companies, 26% and 12% respectively neither agreed nor disagreed with the suggestion that these two items are important.

On the whole, the CFOs of small companies desired that much more academic investment in CFR should be devoted to items 5 (working capital management policies), 21 (project evaluation measures) and 25 (investment banks as a source of funds). Conversely, the CFOs of medium companies gave significantly higher mean scores to 'factors that influence choice between debt and equity' (item 22) and 'use of new securities for risk reduction' (item 24). An analysis of the responses from the three different company sizes using χ^2 test revealed that they differed significantly on the perceived need for six CFR topics. The mean ratings of research importance for items 4, 5, 15, 21, 23 and 25 were significantly different, at the 5% (or less) level for the three groups of respondents. The six issues were perceived as being less important for further research by CFOs of large companies. As might be expected, the disparity in research importance is more pronounced between large and small companies, especially as regards working capital management policies (item 5), cost and value of leveraged buyouts (item 15) and bankruptcy costs (item 23).

It is interesting to observe that 'information transmission and the media used' (item 18), which

Table 4
Cross-size Comparisons of Means and Indexes of Agreements on Importance of CFR Topics

	Small companies n = 37		*Medium companies n = 34*		*Large companies n = 72*		
CFR topics	*Means*	*Adjusted index of agreement*	*Means*	*Adjusted index of agreement*	*Means*	*Adjusted index of agreement*	*Chi squares*
1	3.19	1.21	3.09	1.01	2.87	0.73	6.5709
2	3.68	3.86	3.70	7.32	3.24	1.34	12.4121
3	3.70	3.48	3.59	2.47	3.58	3.75	8.1044
4	3.83	9.64	3.38	1.76	3.21	1.12	13.8781*
5	4.31	∝ (89%)	3.50	2.23	3.14	1.17	38.0639**
6	3.41	2.24	3.18	∝ (74%)	2.96	0.61	11.0890
7	4.05	8.92	4.00	6.59	3.71	3.76	8.1235
8	4.05	26.81	4.09	∝ (88%)	4.17	21.08	6.2506
9	3.54	3.24	3.24	1.00	3.24	1.01	8.9826
10	3.76	5.66	3.65	3.21	3.76	5.44	2.2460
11	3.59	3.21	3.79	4.57	3.63	4.28	5.9396
12	4.16	26.81	4.00	5.33	3.79	4.18	5.7210
13	3.58	2.40	3.13	0.95	3.35	1.71	6.7952
14	3.37	1.84	3.38	1.62	3.40	3.11	7.3144
15	3.51	4.38	3.59	3.21	3.10	0.82	20.0755**
16	3.60	4.09	3.74	4.74	3.42	2.04	4.2167
17	3.74	7.10	3.56	3.21	3.35	1.70	6.1402
18	3.40	1.86	3.71	6.35	3.81	6.22	11.3661
19	4.14	12.00	4.18	6.15	4.00	6.19	8.0700
20	3.82	6.59	3.91	6.15	3.76	4.38	5.5105
21	3.97	12.35	3.41	1.44	3.40	2.17	17.9320*
22	3.56	3.02	3.88	7.04	3.32	1.52	13.3474
23	3.59	2.06	3.18	0.88	2.54	0.12	32.8338**
24	3.73	7.32	3.76	8.46	3.29	1.89	11.7559
25	3.68	8.46	3.35	1.56	2.96	0.69	16.5085*
26	3.76	4.09	3.41	1.41	3.37	1.72	7.9906

* = $p|z| \leq 0.05$; ** = $p\,|z| \leq 0.01$. (xx %) = (% age of unequivocal responses to total responses)

received the second highest index of agreement from large companies and was moderately ranked seventh by medium companies, is perceived by small companies to be less important. Small companies are the ones with the greatest asymmetric information problems. As such, they should be more interested in the process of information transmission. But as one financial director indicated in his write-in comment, 'the disadvantages of media and institutional interference inform our decision not to go public'. It appears that the importance of working capital management policies decreases with company size. For example, the impact of research results on accounts receivables and payables policies (item 5) tends to increase as company size falls and is given a high research priority by small companies. In relation to the top choices of medium and large companies, the high mean score of 4.31, and an almost perfect index of agreement (with only 11% of respondents being 'unsure' and no disagreeing responses) earned by item 5 reflect the importance of working capital to small companies. By contrast, only a small percentage of the CFOs of medium/large companies considered research on working capital an important topic. However, the results suggest that the medium/large companies perceive research on restriction of their freedom to choose disclosure practices for reporting in financial statements (item 11) as more important than do small companies. The greater relevance of disclosure issues to large companies may be because they have (more often than small companies) been a source of continuing political and market concern for information disclosure, and because disclosure usually results in economic consequences, such as cash flow and agency implications, and is often thought to result in reduction of uncertainty. Thus, disclosure restrictions are of little consequence to small companies. This finding is supported by the literature on financial disclosure (see Gray et al., 1984, 1990).

The individual item rankings indicated one approach for assessing research needs in corporate

Table 5
Analyses of Responses by CFR Categories

Panel A: Mean statistics of responses by CFR categories and relationship with company size (standard deviations in parentheses)

	Company size			
CFR category	*Large*	*Medium*	*Small*	*Total*
Operational finance	3.24	3.50	3.77	3.43*
	(0.63)	(0.55)	(0.42)	(0.60)
Regulation	3.73	3.75	3.82	3.76
	(0.53)	(0.62)	(0.42)	(0.53)
Ownership	3.49	3.60	3.61	3.54
	(0.55)	(0.63)	(0.39)	(0.54)
Long-term finance	3.24	3.56	3.75	3.45*
	(0.67)	(0.60)	(0.44)	(0.64)
No. of respondents	72	34	37	143

*Significantly related to company size

Panel B: Comparison of CFR categories: matched t-test results

	Company size			
CFR category	*Large*	*Medium*	*Small*	*Total*
Operational finance and regulation	−5.43*	−2.29*	−0.81	−5.53*
Operational finance and ownership	−3.01*	−1.15	1.20	−2.36*
Operational finance and long-term finance	0.05	−0.54	−0.11	−0.23
Regulation and ownership	3.13*	1.00	2.06*	3.76*
Regulation and long-term finance	5.46*	1.80	0.80	5.22*
Ownership and long-term finance	3.23*	0.69	−0.99	2.27*

*Significant at the 0.05 level or better

finance. A further analysis of the data was conducted by clustering the responses into major corporate finance categories, following Ramírez et al. (1991).[11] The results of this analysis confirmed the results from the earlier single CFR item analysis, which suggest that issues pertaining to regulation (REGU) received the highest ranking of importance whether viewed from the perspective of company sizes or individual companies. This high ranking was corroborated by the relatively high responses in the agree/strongly agree anchor. With the exception of effects of deregulation of the financial services industry (item 9), all the topics under regulation were ranked among the top 10 important items (see Table 2). On the other hand, the operational finance (OPFIN) category was viewed as the least important.

Differences in the perceptions of the importance of research categories by companies of different sizes were also examined, and the results, reported in Table 5 (Panel A), indicate that the importance of research on OPFIN (operational finance) and LTFIN (long-term finance) is decreasing with corporate size. As shown in the table, large companies perceived these two categories as being least important. A further analysis was performed to compare the mean responses of different companies across the categories. The results of the matched t-test (Panel B) confirm that the differences across all the pairs, except the pairs of OPFIN and LTFIN, are statistically significant when tested against a null hypothesis of equal distribution across all categories. The differences are predominantly significant for large companies. Notably, both the pooled and company-size results from this study are consistent with those of the US study by Ramírez et al. (1991).

Influence of Company Characteristics on Perceptions of Research Needs

To investigate the link between company characteristics and respondents' perceptions of academic CFR, we employed two different model specifications (logistic regression and ANOVA), using each of the 26 CFR items (in the Appendix) as a dependent variable. The independent variables exam-

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[11] The results of this analysis are available, on request, from the first author.

Table 6
Influence of Firm Characteristics on Importance Perceptions of CFR Topics: Logistic Regression Results

Coefficients (z statistics)

CFR topics	*Size (Turnover)*	*Industry*
2 Effect of ownership concentration on operations		−0.189 (−2.295)*
4 Value of liquidity of cash holdings	−0.561 (−2.553)*	
5 Impact of accounts receivable/payables policies	−0.843 (−3.528)**	
12 Effect of pension fund changes		0.183 (2.263)*
15 Cost and value of leveraged buyouts	−0.663 (−2.902)**	
18 Influence of transmission to analysts and investors	0.543 (2.384)*	
21 Project evaluation measures	−0.538 (−2.260)*	
23 Significance of bankruptcy costs	−0.989 (−3.939)**	
25 Value of investment banking services	−0.682 (−2.946)**	

* = p |z| ≤0.05
** = p |z| ≤0.01

Three variables (corporate size proxied by turnover, ownership status - whether a parent company, a subsidiary, an associate or a joint venture - and type of industry) were factored into the logistic regression. No CFR topic is indicated to be dependent on ownership status, and responses on the CFR topics not included in this table do not seem to be affected by corporate size and/or industry status.

ined are TURN (turnover as a proxy for company size); SECTOR (industry class of respondent companies) and OWN (ownership structure of companies). The results of the logistic regressions based on the significance of z statistics ($p \leq 0.05$), suggest that 10 out of the 26 CFR topics may be influenced by turnover and/or industrial sector. The results of these logistic regressions are reported in Table 6. As company ownership structure appears to have no influence on any of the 26 CFR items and none of the predictor variables appears to have any influence on perceptions of all regulatory CFR items and 11 other CFR items, they are not reported on. Industry sector is significant only in two cases: cash flow planning/forecasting and dividend policy issues. There is, however, a strong negative correlation between turnover and items 4, 5, 15, 21, 23 and 25. The influence of company size is more prominent in operational finance and long-term finance issues. Operational finance issues border on short-term planning and analysis and might be described more properly as WCM. These issues are crucial in maximising the value of the company, and the smaller the company and the greater the volatility of the business in which they operate, the more major the managerial concern. Conversely, the larger the company size, the more likely it is to contain the threats from inadequate operational finance.[12] However, as earlier discussion suggests, academic CFR has focused predominantly on long-term financing decisions to the relative neglect of short-term financing decisions. Because short-run financial management is the topic that occupies the largest part of the CFO's time, it is surprising that the topic has not received more attention from academics.

Long-term finance issues, especially those pertaining to project valuation, bankruptcy, and the value of investment banking as sources of funds, are strongly affected by size, though none of the suggested predictor variables appeared to have a significant influence on the choice of capital structure. A frequent (though empirically inconclusive) proposition is that capital structure is industry-specific, because companies in different categories face different business risks. Studies supporting

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[12] Finance literature identifies corporate size, industry class and state of the economy as some of the major determinants of a company's working capital needs (see Pinches, 1992). In the present study, the firm's industry or ownership structure does not seem to have an influence on UK respondents' perceptions of the importance of working capital needs.

Table 7
Summary of Respondents' Write-in Comments

Operational finance (seven responses)

- Effect of translation hedging practices on shareholder wealth
- Effect of government's economic (inflation control) policies on financing decisions
- Exchange rate fluctuations and their effect on company value

Regulation (six responses)

- The influence of privatisation on industrial costs and efficiency
- Effects of self-regulation on financial services
- Pros and cons of tighter regulation in the City

Ownership (12 responses)

- Measures that reflect business performance in the medium to long term
- Whether investors 'reward' short-term focus and 'penalise' long-term performance: do investors prefer short-term returns to long-term benefits?
- Determinants of short-termism; its effects and managerial response
- Effectiveness of shareholder interaction
- The negative impact of media and institutional interference in public share offerings
- Whether investors prefer income growth to capital growth, and the effects on their investment criteria

Long-term finance (two responses)

- Whether providers of long-term finance should take a more active role in the business they are involved with

this proposition included Kester (1986), Kim and Sorensen (1986), Friend and Lang (1988), and Titman and Wessels (1988), and those contradicting the proposition include Bradley, Jarrel and Kim (1984) and Kester (1986). The results reported in Table 6 seem to corroborate the findings of the latter group of studies, that capital structure is neither industry-specific nor company-specific.

The second test, ONEWAY (with Scheffe), results of which are not reported here[13], was designed to investigate significant differences in the mean responses to individual CFR items based on company characteristics. No differences were observed for ownership structure or industrial sector. Significant differences due to company size were noted in the cases:

1. Between small and large companies with respect to value of cash holdings.
2. Between small and medium/large companies with respect to impact of accounts receivable and payable policies.
3. Between small/medium and large companies with respect to bankruptcy costs.
4. Between small and large companies with respect to sourcing through investment banks.

The first two cases are operational finance issues, while the last two refer to long-term finance. These results generally confirm the findings reported in Table 5.

Analysis of Write-in Comments

There were 27 responses to the solicitation in the questionnaire for write-in comments on topics, within each category, of immediate concern to the respondents. Many of the comments were precise in the topic identification, others were not. However, using how frequently an issue, or another issue close to it, was mentioned, it was possible to rank the responses within each category. A comment is reported if it was mentioned by at least two respondents. The summary of the central themes of respondents' comments is provided in Table 7.

The essential feature of operational finance comments revolves around the impact of exchange rate fluctuations and inflation decisions and company value. Regulatory issues of immediate concern include the consequences of self-regulation and financial services/markets and the costs and efficiency gains of privatisation. Ownership issues of immediate concern are 'measures which reflect long-term business performance', 'investors' reactions to short-term performance' and 'determinants of and managerial response to short-termism'. The general thrust of the comments was that there is immediate operational concern to know more about financial aspects of corporate

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[13] The results are available, on request, from the first author.

Table 8
Comparison of Frequencies of Selected Items between UK Small Companies (37) and US Private Companies (13) in the Ramírez et al. (1991) Study

CFR item	*Country*	*Strongly agree*	*Agree*	*Not sure*	*Disagree*	*Strongly disagree*	*Rank*	X^2
3	UK	21.6	40.5	24.3	13.5	0.0	13	
	US	0.0	69.2	7.7	23.1	0.0	22	6.406
4	UK	17.1	54.3	22.9	5.7	0.0	7	
	US	7.7	30.8	53.9	7.7	0.0	23	4.130
5	UK	41.7	47.2	11.1	0.0	0.0	1	
	US	25.0	41.7	8.3	25.0	0.0	15	9.184
8	UK	24.3	59.5	13.5	2.7	0.0	4	
	US	46.2	46.2	7.7	0.0	0.0	1	2.577
9	UK	13.5	40.6	35.1	8.1	2.7	21	
	US	30.8	38.5	15.4	15.4	0.0	8	7.250
10	UK	13.5	59.5	16.2	10.8	0.0	9	
	US	7.7	53.9	30.8	7.7	0.0	18	1.464
14	UK	5.7	45.7	28.6	20.0	0.0	25	
	US	33.3	16.7	33.3	16.7	0.0	15	7.481
15	UK	02.9	54.3	34.3	8.6	0.0	22	
	US	33.3	16.7	50.0	0.0	0.0	9	12.752*
19	UK	40.0	40.0	14.3	5.7	0.0	3	
	US	27.3	27.3	45.5	0.0	0.0	10	6.222
22	UK	8.8	55.9	17.6	17.6	0.0	20	
	US	30.8	46.2	15.4	7.7	0.0	4	4.344
24	UK	15.2	48.5	30.3	6.1	0.0	12	
	US	0.0	38.5	53.9	7.7	0.0	24	3.999
25	UK	5.9	61.8	26.5	5.9	0.0	14	
	US	15.4	23.1	61.5	0.0	0.0	21	8.011

* = $p \leq 0.05$

governance and the effect of short-termism on corporate performance and decisions.

Comparison with the US Survey

A comparison of the results of the two national surveys reveals a considerable amount of agreement in the profiling of the importance of CFR items by respondents from the two countries.[14] The similarities are particularly striking between large companies. The results also suggest that significant differences exist, especially between UK small companies and US private companies. This is reported in Table 8, which identifies 12 corporate finance issues on which there are the most notable differences in perceptions.[15] CFOs of UK small companies considered items 4 (value of liquidity of cash holdings), 5 (impact of accounts receivable and payable policies), 10 (regulators' awareness of financial performance issues) and 19 (investors' reactions to short-term performance) to be relatively more important than do their US counterparts in privately-held companies. On the other hand, items 8 (influence of tax laws on financial decision-making), 9 (effects of deregulation of financial services industry), 14 (dividend policy decisions) and 15 (cost and value of leveraged buyouts) were perceived to be more important by US financial managers compared to their UK counterparts.

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[14] These results are offered with caution. Comparative internal consistency tests (ICC(2)) for both countries in respect of the four clusters of topics, reported below, suggest differing levels of internal consistency. There appears to be relatively greater agreement among UK CFOs in respect of all the long-term finance items than in respect of the other three clusters. This contrasts with Ramírez et al.'s (1991) study, which reported ownership area to have the maximum internal consistency with all the seven items. To attain maximum inter-cluster ICC(2) values, one or two items within a cluster needed to be eliminated.

Comparative ICC(2) alphas

Corporate finance area	Items providing maximum ICC(2)			
	US		UK	
Operational finance	Items 2. 3. 4. 5. 6. 7:	α=0.67	Same items as in US:	α=0.74
Regulation	Items 8. 11 & 12:	α=0.57	Items 9. 10. 11 and 12:	α=0.57
Ownership	All items (13-19):	α=0.70	Same items as in US:	α=0.64
Long-term finance	Items 20. 21. 22. 25 & 26:	α=0.73	All items:	α=0.76

[15] Apart from being the groups with the largest disparity in perceptions/rankings, a casual observation suggests that a more interesting comparison would be between small firms in the present study and private firms in Ramírez et al.'s study. For the statistical analysis, frequency distribution was chosen in preference to say mean-related tests because the data was readily available which lent itself to computation of chi-squared tests.

An analysis of the responses from the two different groups of subjects by means of χ^2 test revealed that they differed significantly on one variable only. The mean importance rating for item 15 (cost and value of leveraged buyouts) was significantly different for the two national groups of respondents. The item was, on average, viewed by the US respondents as highly important for research purposes (ranked fourth), while it was not so viewed by UK respondents (ranked 21st). The differential ratings reflect the disparity in the growth and use of leveraged financing in the two countries. Leveraged financing was made fashionable in the US, where 'junk' bonds are mainly used to finance leveraged buyouts and management buyouts. There is as yet no 'junk' bond market in the UK, although it was expected that one would develop following the Hoylake takeover bid for BAT Industries in 1989 (Blake, 1990, p. 80). However, it is not likely that many UK CFOs would be enthusiastic about this topic, given that, with the recession, many recently completed and highly complex takeovers are having a severe impact on companies that borrow heavily.

Conclusion

The purpose of this study was to explore the views of UK CFOs on the research importance of CFR topics adapted from a similar earlier US survey. Evaluation was made using responses to a mail survey of CFOs from 73 large, 34 medium and 37 small UK companies. The study has contributed to the literature in three ways: (1) it offered a (UK v. US) comparison of how financial managers perceive the importance of academic CFR in the two countries; (2) it suggests that company size may have a more significant impact on corporate perceptions of research needs than other company characteristics; and (3) it suggests that there are gaps between current academic CFR and the CFR which CFOs would like to see undertaken. The findings of the study are broadly similar to those reported by Ramírez et al. (1991) in respect of the US.

In general, the results confirm the conclusion by Tomkins et al. (1995) that a large part of financial management research as reported in the leading academic journals still has scant regard for what actually occurs in specific practical contexts. In addition, the results suggest that the needs for academic CFR by CFOs are not necessarily homogeneous, and that every part of it is perceived to have the level of need. CFOs of small companies did not necessarily share the same views as those of large companies. In terms of the effects of company characteristics in shaping the CFOs' perceptions of the importance of academic CFR topics, only company size was implicated, especially on issues pertaining to operational and long-term finance. Overall, there was no evidence to suggest that corporate ownership structure influences CFOs' perceptions of the importance of CFR topics. Additionally, the research importance of regulatory issues is found to be independent of company characteristics.

The revelation that the perceived importance of many of the CFR topics differ according to corporate size is a sign that reformative thinking leading to a better understanding of the financing decision process is sorely needed. The results also indicate that the greatest need is for further research into issues concerning regulation and ownership. The influence of tax laws on financing decisions and investor reactions towards short-term focus were the key fundamental issues in which UK CFOs would like to see further research. On the other hand, respondents did not consider the significance of bankruptcy costs or the influence of the City (such as the financial press) crucial for further research. While many extant CFR models are internally consistent and mathematically sound, they do not explain observed corporate behaviour and do not provide a better understanding of the decision process in corporate finance.

We need empirical research: we do not want for theories, but we do want for theories that have been adequately tested against empirical data. Some might argue that CFR should be and is designed to answer questions of 'relevance' and importance for the operation of both national and international financial systems, not questions about the internal operations of the company and the processes by which corporate financing decisions are reached. The determination of what is 'relevant' CFR is complex, and the implication of research that may emerge from the results of our research are not obvious. We can only conjecture as to the meaning of some of the survey results. The high priority assigned to CFR item 19 (investors' reaction to short-term performance) may be the result of real agreement, or the result of differences in interpreting investors' reactions. However, the results of this study suggest that there is a need for more concern for the whole array of variables that realistically confront and determine the company's behaviour. In other words, academic CFR has to study real behaviour in real companies, amid their complexity.

The study has its own limitations. Implicit in it is the assumption that academic research lacks correspondence with reality and that the current agenda of academics represents their understanding of users' needs. Research is not always done for the purpose of fulfilling the needs of practice. Many CFR problems are presented in terms sufficiently general to defy an answer by perpetuating controversies about problems with no answers and then pursuing the answers in a manner analogous to a quest for the Holy Grail. CFOs, on the other hand, have been put forward as people in need of research that would tackle problems that correspond with reality—which are those for which there are answers. Thus, we assumed that an essential part of the purpose of CFR is to provide answers and guide behaviour in otherwise difficult situations. The results from a study of CFOs' perceptions of the importance of an academic research agenda that does not consider the academic perceptions of the relevance of their research agenda to practice can only be tentative. It would be fruitful to ascertain financial academics' views on these topics with a view to determining potential differences or similarities between them and practitioners alike, and to establish if indeed there is a user-supplier gap in CFR.

In addition, CFOs are not the only users of CFR outputs. Perhaps other users would perceive the importance of each of the 26 CFR topics differently. This suggests the need for more research to determine the primary users of academic CFR outputs and then to discover their research needs. The CFR topics investigated were developed from works that have appeared in the literature. These topics are only a sub-set of the research carried out by academics. Published works have been used in this study to represent the habits and preferences of scholars, but these may reflect the constraining effects of the invisible college of reviewers and editors rather than rational academic choices. Perhaps the CFR topics to be investigated would be different, had this been collected through a Delphi method from selected academic researchers

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Appendix

Questionnaire on Corporate Finance Research Topics administered to Top 500 UK Companies

	Levels of agreement on importance				
CFR topics	*Strongly agree*	*Agree*	*Not sure*	*Disagree*	*Strongly disagree*
Operational financing issues:					
1. Influence of the City on day-to-day financial operations (e.g. *Financial Times*)	5	4	3	2	1
2. Effect of ownership concentration on operational decision	5	4	3	2	1
3. New techniques for asset-liability management	5	4	3	2	1
4. Value of liquidity of cash holdings	5	4	3	2	1
5. Impact of accounts receivable and payable policies	5	4	3	2	1
6. Seasonality impact on operational decisions	5	4	3	2	1
7. Cash flow planning and forecasting	5	4	3	2	1
Regulation issues:					
8. The influence of tax laws on financial decision-making	5	4	3	2	1
9. Effects of deregulation of financial services industry	5	4	3	2	1
10. Awareness of regulators of financial performance issues	5	4	3	2	1
11. Effects of financial statement restriction	5	4	3	2	1
12. Effects of pension fund law changes	5	4	3	2	1
Ownership issues:					
13. How stock prices are determined	5	4	3	2	1
14. How to determine dividend policy	5	4	3	2	1
15. The cost and value of leveraged buyouts	5	4	3	2	1
16. Management's role in attempting to avoid hostile takeovers	5	4	3	2	1
17. How shareholder concentration affects company value	5	4	3	2	1
18. The importance of transmitting information (and media used) to analysts and investors	5	4	3	2	1
19. Whether investors 'penalise' firms for concentrating on short-term performance, ignoring long-term benefits	5	4	3	2	1
Long-term financing issues:					
20. Measures for determining the riskiness of a project	5	4	3	2	1
21. Measure for valuation of an individual project	5	4	3	2	1
22. Factors that influence the choice between debt and equity financing	5	4	3	2	1
23. The significance of bankruptcy costs	5	4	3	2	1
24. Uses of new securities to reduce financial risk	5	4	3	2	1
25. The value of investment banking as a source of funds	5	4	3	2	1
26. The effects of pension funds on company valuation and performance	5	4	3	2	1

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Configural Information Processing in Auditing: Further Evidence

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Abstract—An important issue in audit judgment research has been how auditors combine information in order to make judgments and, in particular, whether auditors' judgments involve configural cue usage. Some recent research (Brown and Solomon, 1990; 1991) has found that under certain conditions, many auditors were able to configurally process information. This paper extends this research by examining some conditions that may facilitate the development of auditors' ability to configurally process available information. The study found that: (a) the proportion of auditors processing the information configurally was greater than chance; (b) for those that processed the information configurally, the form of the interaction was as predicted, that is, ordinal with a compensatory form; (c) increasing depth of processing by requiring subjects to provide explanations for their judgments did not have a significant effect on the number of auditors processing configurally; (d) the level of consensus was higher for auditors who processed configurally than for those who did not; and (e) the analysis of the explanations provided by configural cue processors indicated that they saw the relevant cues as being substitutable.

Introduction

Much of our knowledge of how auditors make judgments has been developed from the policy-capturing literature. These studies examine cue usage in the judgmental process and have attempted to make explicit the mysteries and folklore of professional judgment (Libby, 1981). The main issues addressed by policy-capturing research are between judge consensus, the relative importance of individual cues in the judgmental process, the functional form of the judgmental rule and the judges' level of self-insight of their judgmental processes.

One of the key issues addressed in the policy-capturing research in auditing (see Libby, 1981; Ashton, 1982 and 1983) is whether auditors integrate information in a configural manner. Configural information processing is 'cognition in which the pattern (or configuration) of stimuli is important to the subsequent judgment/decision' (Brown and Solomon, 1990, p. 19). Prior policy-capturing studies in auditing (e.g. Ashton, 1974) have employed ANOVA to model subjects' judgments and have used the judgment variance attributable to interaction terms to examine the extent of configurality. The importance of this issue is emphasised by Libby (1981, pp. 31–32), who suggests that knowledge of the relative importance of individual cues and the functional form of the judgment rule used can help in training novice decision makers and provide an explanation for disagreements between judges. He also suggests that explicit specification of judgmental policies can serve as a starting point for the evaluation of policies used. Configural cue processing is also important because it can improve audit effectiveness and efficiency (Brown and Solomon, 1990, pp. 34–35).

A major finding of the studies that have examined configural cue processing (for example, see review by Brown and Solomon, 1990) is that auditors' judgments are best characterised by linear additive rather than configural cue usage. Two recent papers (Brown and Solomon, 1990 and 1991) have advanced this literature by showing that auditors do in fact configurally process information to a much greater extent than would be indicated by previous studies. The researchers contend that the earlier lack of evidence is indicative, *not* of auditors' inability or unwillingness to configurally process information, but rather that there has been inadequate development of the meaning (i.e. the form and nature) of configural information processing in the context of specific auditing tasks. Brown and Solomon contend that previous research has failed to reveal configural information-processing strategies because the tasks employed did not require the auditors to access the domain-specific knowledge that would lead to their use. They suggest that the tasks set have primarily been ones in which independent information processing would be considered by the auditor-subjects to be appropriate. Therefore, Brown and Solomon developed cases where the relevant interaction was specified ex-ante. Their results (Brown and Solomon, 1990 and 1991) supported their contentions, providing evidence that a substantial proportion of auditor-subjects' judgment models attributed a significant judgment variance to the identified configural strategies.

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There are a number of differences between Brown and Solomon (1990, 1991), and previous studies, which could explain the increase in configural processing in the former studies relative to the latter: (a) the nature of the interaction was specified ex-ante; (b) there was a microcomputer application as opposed to 'paper and pencil' in previous studies; (c) a decision aid was used to reduce memory load and control extraneous judgment variance; and (d) training procedures were introduced.

Training procedures are of particular interest to this paper. As part of this training, subjects responded to a series of questions designed to stimulate prior thought about each item on the checklist and its relation to specific audit objectives about which they were being asked to make risk assessments. For each of the listed audit procedures, the subjects were asked to think about what could go wrong or misstatements that could go undetected if the procedures were not performed. Each subject was also asked to write their thoughts down and to indicate the procedure's importance for achieving the specified audit objectives. In effect, these training procedures have allowed subjects to engage in deeper processing of the cues given. This deeper processing is likely to lead to greater configural cue processing (Choo and Firth, 1993).

Although the Brown and Solomon (1990, 1991) papers have shown that configural cue processing does exist under certain circumstances, it should be noted that a considerable number of auditors did not process configurally. For example, for their audit procedure case (Brown and Solomon, 1991) and their internal control case (Brown and Solomon, 1990) it was found that 55.1% and 40.5% of auditors respectively processed information configurally. Based on these latter results, Brown and Solomon (1990, p. 35) suggest the need for further research on (a) what factors increase the likelihood of auditors' processing information configurally, and (b) why some auditors process information configurally while others do not.

This paper has four main objectives. First, we replicate the first two hypotheses tested by Brown and Solomon (1991), using the same cases but in a setting without microcomputer administration, the assistance of the discussion aid or training. Thus the setting we use is similar to the one used in earlier configural information processing studies. Second, the paper provides additional information on the factors that increase the likelihood of auditors' processing configurally, by examining the effect of depth of processing on the level on configural processing. Third, it examines the relationship between configural processing and one measure of auditor performance, namely, consensus. Fourth, by examining the reasons provided for judgments it offers some insight into why some auditors process information configurally while others do not.

Previous research

Auditing research first became interested in the application of the policy-capturing paradigm to modelling the auditor's judgment process with Ashton's 1974 paper. Researchers have generally used the policy-capturing paradigm to investigate auditors' judgments and have employed ANOVA judgment models in a manner similar to that of earlier psychology studies (see Ashton, 1982 and 1983 and Libby, 1981 for reviews; and Ashton, 1974; Ashton and Kramer, 1980; Hamilton and Wright, 1982; Hall et al., 1982; and Trotman et al., 1983 for examples).

The general result of these studies with respect to configural information processing has been similar to that of the psychologists. While some examples of configural information processing have been produced, these studies have shown that the great majority of judgment variance in this area can be explained by a simple additive combination of a small number of internal control cues (Ashton, 1983) and that the studies have been unable to provide systematic evidence that auditors configurally process information (Brown and Solomon, 1990).

Similar to the situation in psychology, there appears a general belief that experts (auditors) process information configurally, even though this is not supported by the studies' results. For example, Mock and Turner (1981) state that 'on the surface, at least, these findings represent a paradox. How can simple decision rules represent a decision that seems highly complex and nonlinear?'

Brown and Solomon (1990), after examining the procedures and materials employed in previous auditing studies, concluded that none of the studies captured two or more control features that related to the same control objective in such a way that configural information processing would be 'a salient appropriate strategy'. They emphasised the need to consider the role of domain-specific knowledge in developing a priori expectations for configural information processing. They further suggested the need to design tasks that lend themselves to the application of domain-specific knowledge that indicates that configural information processing is appropriate, and the need to specify the form and nature of such configurality. They developed a laboratory study to investigate whether auditors employ configural information strategies when assessing cash disbursements' control risk, and found that a substantial portion of subjects' judgment models (40.5%) attributed significant judgment variance to the control interactions representing a priori identified configural processing strategies.

Brown and Solomon (1991) generalised the concept that auditors will exhibit configural cue processing in situations where domain-specific knowledge implies that it is appropriate. They conducted two experiments. The first examined auditor assessments of account misstatement risk given evidence produced by specified substantive audit procedures. The second experiment examined the same judgment given the results of specified analytical audit planning procedures. They hypothesised and found a compensatory-form ordinal interaction for the first case and a disordinal interaction for the second experiment. For experiments 1 and 2, 55. 5% and 95.5% of the auditors respectively had the hypothesised interactions.

Development of Hypotheses

The present study uses the same task as the one used by Brown and Solomon (1991) in their experiment 1. The essence of the Brown and Solomon (experiment 1, 1991) task is the expected interaction between confirmation of accounts receivable (viewed as the primary procedure) and verification of sales transactions and observation of subsequent collections (the alternative procedure). They suggest that when the auditor is faced with the task of determining the existence of accounts receivable, a useful procedure is to directly confirm the recorded balances with the firm's debtors. However, when a substantial number of confirmation requests are not returned, or returned with 'exceptions noted', the auditor is forced to rely on other 'fall-back' procedures such as verification of sales transactions and observation of subsequent collections. Therefore, these procedures can be understood as being to some extent substitutable (or compensatory) for each other. In the case of maximum substitutability, given that one procedure has been performed, the additional performance of the second procedure would add no incremental benefit. The degree of substitutability will be reflected in both the incremental benefit of the addition of one procedure in the presence of the other, and the difference in 'existence' risk between the two combinations of one procedure in the absence of the other.

In an ANOVA model, such an interaction is termed compensatory-form ordinal. Ordinality means that a conditionally monotonic relation exists between the independent and dependent variables such that positive (negative) evidence resulting from any given audit procedure implies lower (higher) misstatement risk judgment, regardless of the 'sign' of evidence originating from other audit procedures. Compensatory-form means that the two audit procedures in question are expected to be at least partly substitutable to some degree. Further, the marginal benefit of performing one procedure in the absence of the other is greater than the marginal benefit of adding either procedure in the presence of the other. This situation is presented graphically in Figure 1, which is adapted from Brown and Solomon (1991). In Figure 1, the gap between points A and B in terms of misstatement risk reflects the incremental benefit of performing the alternative procedure (verification and observation) when the primary procedure (confirmation) is also performed. The slope of the line connecting points B and D depends on the extent to which the alternative procedure compensates for the primary. In the case of complete substitutability, this line would be horizontal.

We attempt to replicate the first two hypotheses tested by Brown and Solomon in a setting where neither microcomputer administration, the assistance of the decision aid nor training exist.

H1: **The proportion of auditors having an above-criterion (defined below) portion of judgment (misstatement risk) variation attributable to an interaction of substitutable audit procedures (i.e. confirmation of accounts receivable and verification of sales transactions/observation of subsequent collections) will be significantly greater than chance.**

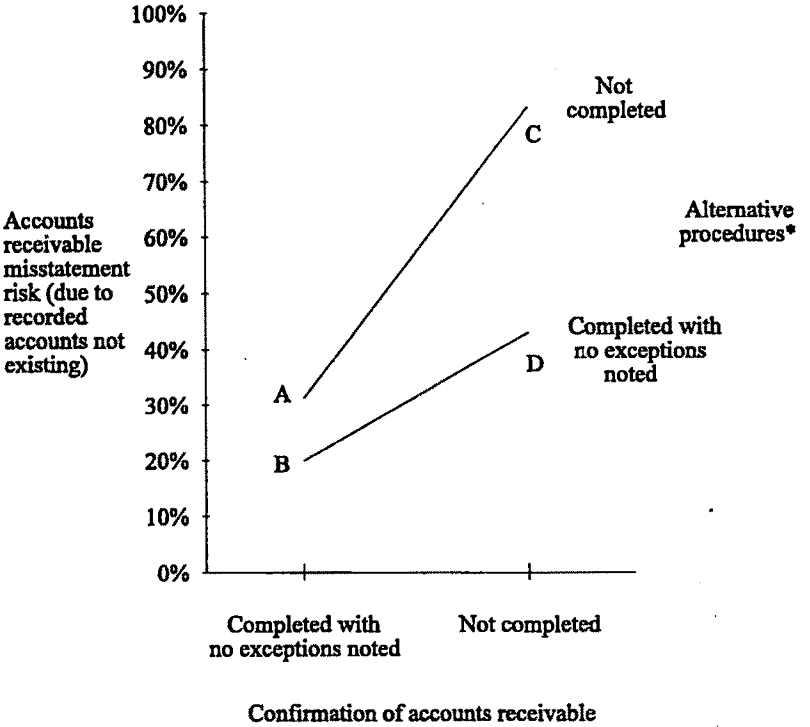
H2: **For auditors having an above-criterion portion of judgment (misstatement risk) variation attributable to the expected interaction, such interaction will be ordinal with a compensatory-form. This interaction will have the following specific attributes:**

(a) When neither substitutable audit procedure has been performed, misstatement risk assessments will be significantly larger than when a single substitutable procedure has been performed.

(b) When both substitutable audit procedures have been performed, misstatement risk assessments will not be significantly smaller than when only a single substitutable procedure has been performed.

Our third hypothesis examines the effect of depth of processing on the extent of configural cue processing. Choo and Firth (1993) suggest that configural information processing requires deeper cognitive processing than non-configural information processing. In practice, various mechanisms exist that are likely to result in deeper processing. For example, subjects are usually required to jus-

Figure 1
Example of a Compensatory-Form Ordinal Interaction
(Adapted from Brown and Solomon, 1991, p. 105)



*Verification of sales transactions and observations of subsequent collections.

tify their judgments through such mechanisms as rationale memos. This process is likely to result in subjects analysing situations more deeply and committing more cognitive effort (Tetlock, 1985; Cloyd, Frederickson and Hill, 1994). One such method of increasing depth of processing is to ask subjects to think through the possible consequences of certain combinations of cues. Brown and Solomon (1990, 1991) achieved this by their training. In the present study, we manipulate whether subjects provide explanations for their judgments. For those subjects that are not asked to provide explanations, the depth of processing could vary substantially between subjects. However, we suggest that those subjects who are required to provide explanations for their judgments all need to think through the implications of the cue combinations. This is likely to result in a search for conceptual schema to account for the pattern of cues that will result in deeper processing (Hastie, 1981). On average, the increased depth of processing by subjects that provide explanations compared to those that don't is likely to lead to greater configural information processing.

H3: The proportion of auditors exhibiting above-criterion variance to the interaction of cues A and B (see Exhibit 1) will be greater for the subjects who are asked to provide explanations compared to those who were not.

Libby (1981) suggests that understanding the functional form of the judgment rule used can provide an explanation for disagreement between judges. Furthermore, Ashton (1982) divides judgment agreement between agreement in fact and in principle. Agreement in fact concerns the similarity of overall judgments, while agreement in principal relates to the similarity of judgment policies. He states that differential cue weighting is one important reason for less than perfect agreement in fact. In hypothesis 4 we suggest that auditors who utilise configural information processing strategies will have greater between-judge consensus (agreement in fact) than those that don't. The experimental task was designed so that auditors should

Exhibit 1
Example of an Accounts Receivable Audit Procedures Checklist

	Procedure	*Results*
A.	Confirm a 95% reliability sample of year-end A/R (positive form).	Not completed as of this date
B.	Verify sales transactions for, and observe collections of, a 95% reliability sample of year-end A/R.	Completed with no exceptions noted
C.	Reconcile A/R subsidiary ledger to the general ledger control account.	Completed with no exceptions noted
D.	Verify adequacy of allowance for bad debts using analytical procedures.	Completed with no exceptions noted
E.	Review aged A/R listing for related party transactions, long-term notes, etc.	Not completed as of this date
F.	Review of board of directors' meeting minutes and correspondence files to determine if receivables were factored or discounted.	Not completed as of this date

Given the audit evidence as represented by the partially completed audit program segment (above), assess the risk that the year-end accounts receivable balance could be materially misstated as a result of recorded accounts NOT EXISTING.

employ configural information processing strategies when assessing risk. Brown and Solomon (1991, p. 103) note that 'the auditing knowledge required to appropriately perform this task implies an ordinal interaction of a particular form'. Use of this strategy is expected to result in subjects having a higher level of agreement in principle, leading to a higher level of between-judge consensus. On the other hand, subjects who do not use this strategy may adopt a range of other strategies, with the result that these subjects will exhibit lower levels of agreement in principle and therefore lower between-judge consensus.

H4: Auditors who utilise configural information processing strategies will have greater between-judge consensus than auditors who utilise non-configural information processing strategies.

Research methods

Subjects

The subjects were 50 seniors/managers from one Australian 'Big Six' firm who were attending a staff training course. The average experience level was three years seven months.

Research design

The research design was one-half fractional replication of a five-cue factorial ANOVA, with each cue involving audit procedures for accounts receivable. Each of the five cues had two levels. In addition, the depth of processing level was manipulated between subjects. Subjects in treatment 1 made the judgments without providing reasons, and subjects in treatment 2 were asked to give reasons for their judgments.

Materials

The materials used were the same as those used in Brown and Solomon's (1991) experiment 1. It consisted of a hypothetical audit case including part of an audit programme for accounts receivable. Subjects were told that they would be given a series of checklists, each representing a partially complete portion of the accounts receivable audit program, and would be asked to assess risk of misstatement of the account. Risk was elicited using a 100-point scale (0 was no risk and 100 was maximum risk) by asking subjects to 'assess the risk that the year-end accounts receivable balance could be materially misstated as a result of recorded accounts NOT EXISTING'.

The example of the accounts receivable audit program checklist (taken from Exhibit 1 of Brown and Solomon, 1991) is shown in Exhibit 1. Five of the six audit procedures (A, B, C, E and F in Exhibit 1) were factorially manipulated at two levels each ('completed with no exceptions noted' or 'not completed as of this date'), and one procedure (D in Exhibit 1) was held constant ('completed with no exceptions noted'), as noted by Brown and Solomon (1991).

Confirmation of accounts receivable (procedure A) and verification of sales transactions/observation of subsequent collections (procedure B) were intended to be substitutable accounts receivable audit procedures, and thus are the constituent variables of the interaction expected in the first hypothesis. Procedures C through F were intended to be accounts receivable audit procedures less directly related to the existence assertion.

In addition, subjects in treatment 2 were asked to state the reason for each risk assessment as follows:

> For this case, please state how the year-end receivable balance could be materially misstated as a result of recorded accounts not existing. If you believe no major misstatements are likely to go undetected, please state why.

Procedures

Subjects attended training sessions on one of four days. The subjects with over two years' audit experience who attended the first day (23 subjects) were allocated to treatment 1, that is, subjects who were not required to state reasons for their judgments. All subjects completed the cases within 25 minutes. The subjects with over two years' audit experience who attended on later days (27 subjects)[1] were allocated to treatment 2. These subjects were asked to provide reasons for their judgments as they completed each case. All subjects completed the 16 cases within 45 minutes.[2]

Subjects were presented sequentially with the 16 checklists from the half-replication factorial design. The order (i.e. the cue combinations) was randomised for each subject. In addition, the order of the items on the checklist was counter-balanced; subjects received one order for half the cases (the two substitutable audit procedures were listed first) and received a second order for the other cases (the two substitutable audit procedures were listed last).

Results

Overall ANOVA models were calculated for the two treatments, with the results presented in Tables 1 and 2. The results show the interaction expected in the hypotheses (AB in Tables 1 and 2) was significant for both treatments ($F[1,352] = 3.935$; $p < 0.05$ (treatment 1): $F[1,416] = 8.462$; $p < 0.01$, (treatment 2), Tables 1 and 2 respectively).[3] Next, consistent with Brown and Solomon (1990, 1991) individual ANOVA models were computed for each auditor-subject's risk assessment. For each model, all five main effects and 10 two-way interactions were estimated; the higher-order interactions are assumed to be negligible. These individual models are determined fully, as each has only one observation per cell and no error estimate exists. Therefore, the variation in judgment attributed to each term in an auditor-model was computed by dividing the sum of squares for the term by the total sum of squares for the model. Consistent with Brown and Solomon, a criterion of greater than or equal to 4% of total judgment variation was used to determine significance. That is, 'terms to which a model attributes judgment variation less than 4% of total variation are assumed to have been caused by random rather than systematic effects' (Brown and Solomon, 1991, p. 106).

Table 3 shows the number of audit-models that exhibit above criterion variance to the interaction of cues A and B for each treatment. Hypothesis H1 states that the observed proportion of auditor-models attributing greater than 4% of total judgment variation to the expected interaction will be *greater than chance*. Following Brown and Solomon (1991), we construct a 95% confidence interval for the observed proportion and accept hypothesis H1 if zero lies outside this range.

For treatment 1, five of the 23 auditor-models (22%) attributed above-criterion variation to the expected interaction. This frequency is greater than chance using the Brown and Solomon approach (a 95% confidence interval for this frequency is 5.1% to 38.9%) and provides support for hypothesis H1. The mean judgment variation attributed by the five auditor-models to the expected interaction (AB in Table 4) was 11.3% (a 95% confidence interval for this mean is 2.46% to 20.14%).

For treatment 2, 10 of the 27 auditor-models (37%) attributed above-criterion variation to the interaction expected in hypothesis H1. This frequency is significantly different from chance (the 95% confidence interval for this frequency is 18.8% to 55.2%) and supports hypothesis H1. The mean judgment variation attributed by the 10 auditor-models to the expected interaction (AB in Table 5) was 9.97% (a 95% confidence interval for this mean is 8.1% to 11.8%).

Hypothesis H2 concerned the form and nature of the expected interaction. Visual inspection of the form of the above criterion interactions in both treatments 1 and 2 reveals that all 15 (five in treat-

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[1] Other staff members from areas such as tax and insolvency also attended on these days but were not part of the experiment because they did not have the required audit experience.

[2] Although subjects in treatment 1 took less time to complete the task, they were not under more time pressure. In fact, it appeared that more subjects in treatment 1 had completed the task five minutes prior to collecting the material than was the case for subjects in treatment 2.

[3] The only other significant interaction on the overall ANOVA models is the BC interaction in Table 2. Analysis of individual ANOVA models later in this section of the paper shows that this appears to be driven by a small number of subjects.

Table 1
A 2^5 ANOVA on Configural Information Processing for Treatment 1 (Did Not Provide Reasons)

Source of variation	*Sum of squares*	*DF*	*Mean squares*	*F ratio*	*F prob*
Main effects	146571.315	5	29314.263	85.272	0.000
A	76710.156	1	76710.156	223.141	0.000
B	48902.113	1	48902.113	142.250	0.000
C	21825.645	1	21825.645	63.448	0.000
E	1718.852	1	1718.852	5.000	0.026
F	2231.098	1	2231.098	6.490	0.011
Two-way interactions	4436.293	10	443.629	1.290	0.234
A B	1352.795	1	1352.795	3.935	0.048
A C	308.152	1	308.152	0.896	0.344
A E	178.882	1	178.882	0.520	0.471
A F	195.882	1	195.882	0.569	0.451
B C	201.941	1	201.941	0.587	0.444
B E	279.503	1	279.503	0.813	0.368
B F	48.913	1	48.913	0.142	0.706
C E	34.239	1	34.239	0.100	0.752
C F	411.359	1	411.359	1.197	0.275
E F	195.652	1	195.652	0.569	0.451
Explained	151007.609	15	10067.174	29.284	0.000
Residual	121008.696	352	343.775		
Total	272016.304	367	741.189		

Table 2
A 2^5 ANOVA on Configural Information Processing for Treatment 2 (Provided Reasons)

Source of squares	*Sum of squares*	*DF*	*Mean squares*	*F ratio*	*F prob*
Main effects	221221.045	5	44244.209	76.514	0.000
A	159183.188	1	159183.188	275.284	0.000
B	40970.978	1	40970.978	70.853	0.000
C	21629.410	1	21629.410	37.405	0.000
E	1292.098	1	1292.098	2.234	0.136
F	1493.601	1	1493.601	2.583	0.109
Two-way interactions	13120.205	10	1312.020	2.269	0.014
A B	4893.122	1	4893.122	8.462	0.004
A C	1016.931	1	1016.931	1.759	0.186
A E	65.209	1	65.209	0.113	0.737
A F	17.785	1	17.785	0.031	0.861
B C	2239.153	1	2239.153	3.872	0.050
B E	92.511	1	92.511	0.160	0.689
B F	17.785	1	17.785	0.031	0.861
C E	42.669	1	42.669	0.074	0.786
C F	5.007	1	5.007	0.009	0.926
E F	13.380	1	13.380	0.023	0.879
Explained	234341.250	15	15622.750	27.017	0.000
Residual	240550.000	416	578.250		
Total	474893.250	431	1101.840		

Table 3
Number of Auditor-models Attributing Above-criterion Variation to the Interaction of Cues A and B

	Treatment 1	*Treatment 2*	*Total*
Number of significant auditor-models	5	10	15
Total number of auditor-models	23	27	50
Percent significant auditor-models	22%	37%	30%

Table 4
Summary of Auditor Judgment Models: Treatment 1

Judgment models incorporating:					
Only above-criterion terms				*All terms*[1]	
Source[2]	*Mean*[3]	*Std. Dev.*	*n*[4]	*Mean*[3]	*Std. Dev.*
A	40.40	20.50	23	40.40	20.50
B	28.40	16.30	21	25.92	17.26
C	29.04	24.08	12	15.97	22.13
E	21.82	21.60	4	4.36	12.00
F	5.83	1.56	5	2.12	2.21
All main effects	81.56	5.32	23	88.80	5.35
AB	11.30	7.12	5	3.62	7.40
AC	5.91	0.00	1	0.81	1.29
AE	4.42	0.00	1	0.91	1.13
AF	0.00	0.00	0	0.82	1.13
BC	10.31	0.00	1	1.18	2.18
BE	0.00	0.00	0	0.80	0.86
BF	4.07	0.07	2	0.94	1.17
CE	5.71	0.00	1	0.61	1.24
CF	4.01	0.00	1	0.80	0.97
EF	0.00	0.00	0	0.68	0.77
All interactions	11.98	7.27	23	11.20	7.40
Residual	6.46	4.23	12		

[1] The number of auditor-models (n) equals 23.
[2] The expected interaction is AB.
[3] Judgment variation attributed to the respective main effect or interaction.
[4] The number of auditor-models for which the specified term is above-criterion.

ment 1 and 10 in treatment 2) were compensatory-form ordinals, thus providing support for the initial part of hypothesis H2. The mean risk assessments for each level of the expected interaction for both treatments are presented in Tables 6 and 7 respectively. A one-way repeated measures ANOVA reveals significant differences between these means for both treatments (treatment 1: F[3,12] = 12.99, $p<0.000$; treatment 2: F[3,27] = 59.92, $p<0.000$). Tukey's test for differences between specific levels of the interaction for treatment 1 reveals that the mean risk assessment is significantly higher when neither substitutable control was in place (NN in Table 6) than when either (or both) control(s) was (were) performed (YN, NY, YY in Table 6). This provides evidence in support of hypothesis H2a, that is, the performance of either procedure in isolation, or both procedures in combination, results in significantly lower mean risk assessment than when neither control was performed. Further, mean risk assessment was not significantly smaller when both controls were in place (YY in Table 6) compared to when only one (but not both) controls were performed (YN and NY in Table 6). This provides evidence consistent with hypothesis H2b, i.e., there is no significant marginal benefit of performing both procedures over the benefit of performing ei-

Table 5
Summary of Auditor Judgment Models: Treatment 2

	Judgment models incorporating:				
	Only above-criterion terms			*All terms*[1]	
Source[2]	*Mean*[3]	*Std. Dev.*	*n*[4]	*Mean*[3]	*Std. Dev.*
A	55.80	25.34	26	53.73	27.00
B	19.08	20.03	20	14.45	18.94
C	27.63	24.61	10	11.16	19.63
E	7.83	3.16	5	2.05	3.17
F	5.09	1.18	6	1.84	2.07
All main effects	82.44	9.92	27	84.41	9.01
AB	9.97	2.58	10	4.08	4.15
AC	10.42	2.68	2	1.66	2.76
AE	0.00	0.00	0	0.68	0.94
AF	5.42	0.00	1	0.71	1.17
BC	6.56	1.93	3	1.55	2.13
BE	4.12	0.00	1	0.81	1.08
BF	0.00	0.00	0	0.65	0.72
CE	7.10	0.64	2	1.34	1.83
CF	5.66	0.00	1	1.02	1.19
EF	5.44	1.44	4	1.91	2.44
All interactions	10.75	10.13	27	15.59	8.64
Residual	6.81	5.02	27		

[1] The number of auditor-models (n) equals 27.
[2] The expected interaction is AB.
[3] Judgment variation attributed to the respective main effect or interaction.
[4] The number of auditor-models for which the specified term is above-criterion.

Table 6
Misstatement Risk Assessments: Treatment 1

	Levels of the expected interaction			
	YY	*YN*	*NY*	*NN*
Mean (n = 5)	21	32	39.5	75.5
Standard deviation	12.89	13.51	20.19	23.21

ther procedure in isolation. These two results in combination indicate that the interaction was of the expected compensatory-form ordinal type. Tukey tests for treatment 2 reveal similar results con-

Table 7
Misstatement Risk Assessments: Treatment 2

	Levels of the expected interaction			
	YY	*YN*	*NY*	*NN*
Mean (n = 10)	22.55	28.50	42.25	81.25
Standard deviation	15.40	21.12	20.63	19.05

firming the hypothesised form of the expected interaction (see Table 7).

To test hypothesis H3, a chi-squared analysis of the number of significant auditor-models under both treatments was conducted. The results do not support the hypothesis ($\chi^2 = 1.384$, $p<0.25$ ns). However, it should be noted that the results are in the hypothesised direction, and the number of configural cue processors in both treatments are relatively small.

Hypothesis H4 states that auditors who exhibit configural cue processing will have greater between-judge consensus than auditors who do not process information configurally. Auditors who attributed greater than or equal to 4% of overall judgment variation to the interaction of cues A and B were grouped as configural information processors (CIP). The other auditors were classified as non-configural information processors (non-CIP). Each auditor's judgments were correlated with the judgments of each other auditor in that treatment and the mean calculated to determine a consensus level for each group. For treatment 1, the mean level of consensus across all CIP was 0.81, compared to 0.65 for non-CIP ($t = 2.39$; $p<0.01$). For treatment 2 the mean levels of consensus were 0.71 and 0.63 for CIP and non-CIP respectively ($t = 2.16$; $p<0.01$). These results support hypothesis H4 for both treatments.[4]

An additional result of this test of hypothesis H4 is the confirmation of the meaningful nature of the 4% criterion level. While this is an apparently insignificant level of total variation, it nonetheless leads to significant differences in the levels of consensus between groups partitioned on this criterion level. In other words, despite the small amount of variation attributed by the ANOVA models to the interaction of interest, it appears to have a significant impact on the judgments made.

Following Brown and Solomon (1991), we also attempted to confirm the validity of the experimental task. As this task was designed to exhibit a significant interaction on two a priori specified cues, it is anticipated that the frequency of significant expected interactions would exceed the frequency of other (non-hypothesised) interactions. Table 3 shows that five of the auditor models for treatment 1 attributed above-criterion judgment variation to the expected interaction. The second most frequent above-criterion interaction was BF (see Table 4), which was significant for two auditor-models. This frequency is not significantly smaller than that for the expected interaction ($\chi^2 = 1.516$; $p<0.25$ ns). Given such small numbers, further design validity tests are not possible for this treatment.

For treatment 2, the second most frequent above criterion interaction was EF (see Table 5). This frequency is significantly smaller than that for the expected interaction ($\chi^2 = 3.471$; $p<0.06$). Further, the mean judgment variation attributed by the 10 auditor-models to the expected interaction (9.97%) is significantly greater than that attributed by the four auditor-models to this non-hypothesised interaction (5.44%; $t[12] = 3.26$; $p<0.007$).

We also investigated the BC interaction for treatment 2 because of its significance in the overall ANOVA model shown in Table 2. However, it should be noted that, given the relatively small sample, a small number of subjects can have a disproportionate effect on the overall results. In addition, as we are interested in individual processing strategies, we concentrate on the individual results consistent with the rest of our analysis. Table 5 shows that only three of the 27 subjects attributed above-criterion judgment variation to this interaction. Constructing a 95% confidence interval around the 11% (three out of 27)[5] indicates that this proportion is not greater than chance. In addition, consistent with Brown and Solomon (1991) we found that the frequency of this interaction is significantly smaller than for the expected AB interaction ($\chi^2 = 4.964$, $p \leq 0.03$).

Analysis of reasons given for judgments

Recall that subjects in treatment 2 were asked for each case how the year-end accounts receivable balance could be materially misstated as a result of recorded amounts not existing, and, if they believed no major misstatements were likely to go undetected, to state why. The 10 subjects who processed the information configurally can be divided into four categories: (a) four subjects who specifically mentioned B is substitutable for A and noted that existence was adequately covered by B; (b) another four subjects who stated that B partly substitutes for A, but not completely; (c) one subject who stated that B is an effective test for existence, but did not mention that it was substitutable for A; and (d) one subject who mentioned the importance of A with no mention of B as a test of existence.

The 17 subjects who did not process configurally can be categorised as follows: (a) nine subjects emphasised A as the main test for existence; two of these made no mention of B as an existence test; three of these subjects stated that B reduced risk slightly when A was not present (or mentioned that some comfort can be gained for B); three mentioned B as an existence test, but no mention was made of its being used as a substitute for A; one subject, while expressing the importance for A, noted that B does not confirm a balance at any point of time; (b) five subjects made it clear that B could be used as a substitute for A, but then made judgments that did not show up configural use. The specific instances were: (i) two subjects noted that B reduced risk in a case when A was not present; however, for the other three cases when B was present and A absent, the reduction in risk did not occur or was very small; (ii) one subject, while clearly stating that B could be an alternative for A, gave very high risk estimates for the four cases where B was present and A was absent; (iii) one subject stated that B could substitute for A, but all judgments were dominated by the absence/presence of C; (iv) one subject stated that B could be an alternative to A, but there were inconsistencies in how the scale was used[6]; (c) one subject stated that existence could be tested by A or B; however, judgments were affected by a concern with statistical sampling and consequently little reliance was placed on either test; (d) one subject stated that B was the major existence test, and made no mention of test A; (e) one subject did not make it clear which tests related to existence.

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[4] As the assumptions of the t-test may be violated in the above test, a Mann-Whitney test for differences in means was conducted. The results are consistent with those for the t-test except that for treatment 2 the result is marginally significant. (Treatment 1: $Z = -2.58$, $p = 0.01$; treatment 2: $Z = -1.88$, $p = 0.059$).

[5] These figures were six out of 49 in Brown and Solomon (1991).

Overall, it appears from subjects' reasons that the main difference between configural and non-configural processors was that the former believed that B was fully or partly substitutable for A, whereas the latter tended to emphasise A, or, if they did recognize B, only considered that it reduced risk slightly. In addition, there were some non-configural information processors who made judgments inconsistent with their reasoning.

Discussion

Brown and Solomon (1990, 1991) extended previous audit judgment research by showing, over three different tasks, for which task and context-specific auditing knowledge implies that it is appropriate, that many auditors were able to configurally process information. They also note in their comments on the limitations of the study that 'microcomputer administration (instead of paper and pencil), decision aids (intended to reduce memory load and control extraneous judgment variation), and training procedures (to mitigate subject reactivity) all differ from previous studies and could have contributed to the present finding of greater configural information processing than in prior studies'. They conclude that one question that needs to be addressed by future research is: 'What conditions facilitate development of auditors' ability to configurally process available information?'

This paper examined whether the high levels of configural information processing found in Brown and Solomon (1990, 1991) would replicate using the same materials as they used in one of their experiments but without other factors that differed from earlier studies, namely, a microcomputer administration, the use of a decision aid, and training. In addition, it examined whether depth of processing affected the level of configural information processing, the relationship between configural/non-configural cue processing and the level of consensus, and the differences in explanations between configural and non-configural processors.

The main results of the study were as follows. First, while for both treatments the proportion of auditors having an above criterion portion of judgment attributable to an interaction was greater than chance, the percentage of auditors who processed information configurally was less than that found by Brown and Solomon (1991) using the same materials (22% and 37% versus 55.1%). However, while the same materials were used as that in Brown and Solomon (1991), there were many other differences, including the use by Brown and Solomon of the microcomputer application, the decision aid, and training. In addition, subjects were from a different country and there are unknown possible differences in incentives. Second, for those that processed information configurally, the form of the interactions was as predicted, that is, ordinal with a compensatory form. Third, while a higher percentage of auditors processed information configurally from the treatment group that gave explanations, compared to the treatment group that did not give explanations, the differences were not significant. Fourth, in both treatment groups, the level of consensus was higher for auditors who processed configurally compared with those who did not process configurally. If consensus is accepted as a reasonable surrogate for accuracy (Libby, 1981; Ashton, 1982; A. Ashton, 1985), then it can be suggested that increased configural processing is associated with improved performance. Fifth, analysis of the explanations provided by the configural information processors showed that these subjects saw the relevant cues as being substitutable. This was not the case for many of the non-configural processors.

It appears that the most important area of future research related to configural cue processing is to determine why some auditors process information configurally while others do not. Two related issues are what factors increase the level of configural processing across subjects, and whether training, decision aids and various types and combinations of feedback increase the level of configural information processing. The results of the analysis of explanations given by subjects suggest that each of these methods has substantial promise. For example, decision aids could be used to reduce the inconsistencies found among some of the non-configural processors. Training and feedback could be used to ensure that the non-configural processors become more aware of the substitutability of certain procedures.

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[6] Case 9, which had all procedures present except A, was assessed as a risk level of 0.90; case 11, which had all procedures present except A, C and F was given a risk level of 0.3. Clearly, case 9 should have a risk level at least as low as case 11. Inconsistencies such as these could be another reason for differences between the present study and Brown and Solomon (1991), who included a decision aid that prevented these inconsistencies.

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An Empirical Analysis of Thomas's Financial Accounting Allocation Fallacy Theory in a Financial Distress Context

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Abstract—Thomas (1969, 1974 and 1975) theoretically attacked the practice of incorporating major accounting allocations across time such as depreciation and deferred taxes in financial accounting. Instead, he advocated using accrual-based funds statements as alternatives to an income statement (preferably a net-quick-assets funds statement). This paper reports the results of analyses of Thomas's assertions by using the predictive ability criterion, and the ordinal four-state financial distress methodology developed by Ward (1994). Results generally support Thomas's assertions. A net-quick-assets operating flow and an operating flow variable adjusted for depreciation and amortisation and deferred tax allocations are both normally stronger predictors of financial distress than a net income variable. However, contrary to Thomas's theory, the change in inventory, a non-monetary item, appears to be an important predictor of financial distress one year before distress.

Introduction

Thomas (1969, 1974 and 1975) criticised the use of major accounting allocations across time in financial reporting, especially depreciation and deferred tax allocations. However, he never advocated eliminating accrual-based reporting, but instead recommended allocation-adjusted funds statements as alternatives to traditional income measurement. Thomas preferred a net-quick-assets funds statement that included the timing differences in monetary assets and liabilities. This study uses a financial distress criterion (see, for example, Beaver, Kennelly and Voss, 1968) to examine Thomas's Financial Accounting Allocation Fallacy Theory. Our literature review found no financial distress study that specifically examined Thomas's allocation fallacy theory by investigating the predictive usefulness (ability) of either a net-quick-assets operating flow variable or an operating variable adjusted for both depreciation and deferred tax allocations.

The remainder of the paper is organised as follows. Section two reviews relevant prior literature while section three discusses Thomas's theory and the research question. Section four describes the samples used in the study. Section five explains the methodology used. Section six discusses results from analyses, and the final section presents our conclusions.

Prior literature

Some prior researchers tested the predictive ability of adjusted income measures. Early financial distress researchers such as Beaver (1966), Deakin (1972) and Blum (1974) found that a naive operating flow (NOF), net income plus depreciation, was a strong predictor of financial distress. (NOF was normally scaled by total liabilities or total debt.) However, subsequent studies by Casey and Bartczak (1984 and 1985), Gentry, Newbold and Whitford (1985 and 1987), Aziz, Emanuel and Lawson (1988) and Aziz and Lawson (1989) found that adjusting net income further to obtain a cash flow from operations (CFFO) variable did not produce a consistently strong predictor of financial distress.

Laitinen (1994) and Ward (1994) examined the predictive usefulness of NOF and CFFO. Based on the financial flexibility theory developed by Donaldson (1969), Laitinen hypothesised that the importance of accruals and deferrals caused the difference in predictive usefulness. Laitinen primarily used non-parametric tests and univariate models to test NOF and CFFO separately. Results from Laitinen's sample of bankrupt and non-bankrupt firms indicated that NOF is more stable and reliable than CFFO and the inventory and accounts receivable decreases appear to be important adjustments prior to bankruptcy.

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Rather than using a dichotomous bankrupt/non-bankrupt measure, Ward (1994) developed a four-state ordinal measure of financial distress to determine why NOF is such a strong predictor of financial distress. The study's primary objective was to determine what construct NOF measured by testing two competing explanations for NOF's predictive strength; NOF is: (1) a naive measure of financial distress, as stated in early financial distress studies; or (2) an alternative measure of income. To conduct his test, Ward added NOF to a model including control variables, CFFO and a net income variable based on that reported on the income statement. Ward then noted the changes in parameter estimates and test statistics for the net income and CFFO variables, and parameter correlations. He concluded that NOF is not a naive operating cash flow measure, but is a strong predictor of financial distress because it measures the same construct as net income. Consequently, because Laitinen did not compare results of NOF and CFFO with traditional net income, his findings may have resulted from NOF substituting as an alternative measure of net income.

Research by Laitinen and Ward suggests that depreciation may not be useful in predicting financial distress. However, NOF's superior predictive strength compared to CFFO indicates that some accrual items eliminated to calculate cash flow from operating activities may contain useful information. Neither study directly tested Thomas's assertions concerning financial accounting allocations and non-monetary items. Although Ward's results are consistent with Thomas's criticism of depreciation, the objective of his study was simply to determine if the naive operating flow, net income plus depreciation, measured an income construct or cash flow construct.

Ward's variables included many allocations and non-monetary items. For example, Ward did not adjust net income for the deferred tax allocation and non-monetary items such as inventory. He also scaled the naive operating flow variables by total liabilities. Thus, the NOF variable includes deferred taxes in both the numerator and denominator and is still an allocated financial accounting variable. Likewise, Laitinen's study did not adequately address Thomas's assertions, because he did not determine whether or not financial accounting allocations could explain the differences between the predictive ability of NOF and CFFO. Laitinen also did not include control variables in the prediction models with the accrual and deferral adjustments, and his sample included 40 bankrupt and 40 healthy Finnish firms. A larger sample size and including control variables in a model with accruals and deferrals may produce different results.

In a financial distress context, this study focuses on determining the validity of Thomas's assertions in his financial allocations fallacy theory. This study also provides insight into why CFFO fails to outpredict other operating flow measures. We use Ward's methodology and initial sample in this study. However, we extend Laitinen and Ward's research in many respects. First, we examine a net-quick-assets operating flow variable (as suggested by Thomas) and an operating flow variable adjusted for both depreciation and amortisation and deferred tax allocations. We compare results obtained with these variables to results produced by net income and operating cash flow variables. Second, we adjust all scaling measures for the impact of depreciation, amortisation and deferred tax allocations. Third, we also examine all operating flow components (allocations, accruals and deferrals) to help explain differences in results produced by operating flow variables.

Thomas's theory and research question

Allocation Fallacy Theory

According to the allocation fallacy theory espoused by Thomas (1969 and 1974), financial accounting allocations do not represent economic reality. Thomas contends that 'the allocation problem arises because there is no conclusive way to choose one method in preference to all others except arbitrarily' (1974, p. 2). Thomas (1969, p. 84) notes that the allocation problem 'is just one aspect of the more general problem' of income determination. Thomas criticises the use of allocations in the traditional income measurement approach of matching revenues with expenses. He bases his conclusions, in part, on the fact that the *individual* contribution of an input such as an asset cannot be determined because of interactive effects. The interaction of an asset with other inputs (e.g., labour and materials) generates output greater than the combined output generated separately by the individual inputs. Thus, if one cannot determine what the contributions of a firm's individual inputs are, then any attempt to match costs with revenues is bound to fail.

The distance from economic reality becomes greater when using major arbitrary and systematic allocations over time, such as depreciation and deferred taxes. Thomas was especially critical of depreciation, which he called 'a particularly severe instance of the allocation problem' (1969, p. 16) and inter-period tax allocation.

> '[C]ontemporary tax allocation practices embody the allocation problem in

> one of its most pathological forms: an incorrigible allocation is based on the differences between second and third arbitrary allocations—nonsense cubed, as it were' (1974, p. 120).

Thomas states that these non-verifiable and non-refutable accounting calculations (allocations) fail to assist decisions and 'our beliefs in them are fallacies' and concludes that '. . . whenever possible, it [Financial Accounting Standards Board] should eliminate allocations' (1975, p. 68).

To avoid the allocation problem, Thomas (1974) advocated allocation adjusted funds statements as alternatives to an income statement. Of several potential funds statements, Thomas preferred a statement based on a net-quick-assets definition of income or operating flow, 'net quick assets being total cash, receivables, and any other current monetary assets, less current monetary liabilities' (1974, p. 119). Thomas concludes that '. . . insofar as present income reporting goes beyond the data presented on a net-quick-assets funds statement, the additional figures reported are almost always arbitrary' and '. . . little would be lost by preparing funds statements instead of income statements' (1969, p. 101).

However, Thomas still stressed the need for recognising sales and other monetary transactions on an accrual basis. Thus, he did not advocate replacing the income statement with a cash flow statement. Thomas, instead, advocated accrual-based funds statements.

Research Question

To examine Thomas's assertions in a financial distress context, this study incorporates a net-quick-assets operating flow variable and an operating flow variable adjusted for depreciation and amortisation and deferred tax allocations in ordinal logistic regression models. Including a net-quick-assets operating flow variable in a prediction model examines whether it is incrementally useful in predicting financial distress. Although Thomas recommended the use of a net-quick-assets funds statement to eliminate the impact of all financial accounting allocations on income recognition, he was primarily critical of major allocations across time. Including an operating flow variable adjusted for depreciation and amortisation and deferred tax allocations in a prediction model examines whether simply eliminating the two largest allocations across time results in an operating flow variable that is incrementally useful in predicting financial distress. The study also compares the significance of these two variables to the significance of a net income variable to see whether allocations may actually limit the predictive usefulness of reported net income. Models including the components that make up operating flows were also developed to help illustrate differences in the results of the operating flow and income variables.

Selection of developmental and holdout samples

A four-step sampling scheme was used to obtain two separate samples of US firms, a developmental sample of 1988 firms and a holdout sample of 1989 firms. Both samples exclude firms in the finance and banking industries. No firms included in the 1988 sample are included in the 1989 sample.

Table 1 summarises the sample selection process and contains a breakdown of the two samples. The 1988 sample contained 204 firms, of which 150 were healthy, 16 reduced cash dividends, 21 experienced a loan default or debt accommodation, and 17 filed for bankruptcy. The 1989 sample (holdout sample) included 141 firms, of which 103 were healthy, 12 reduced cash dividends, 13 experienced a loan default or debt accommodation, and 13 filed for bankruptcy.

For some firms, the bankruptcy announcement comes before financial reports for the preceding year are issued. Consequently, these financial reports include information about a firm's bankruptcy (see, for example, Ohlson, 1980 for a discussion on this topic). This problem can also occur for firms experiencing a loan default/accommodation. Therefore, this study lags the data one additional year for firms releasing financial reports after the date of loan default/accommodation or bankruptcy. Five 1988 and six 1989 firms were so lagged.

Methodology

Dependent (Response) Variable

Dichotomous response measures such as non-bankrupt versus bankrupt overly simplify the financial distress process. A firm's level of financial distress varies from period to period. Financial distress results from economic occurrences, and many economic events indicate different degrees of financial distress. Consequently, economic events should best capture a firm's true level of financial distress. The use of bankruptcy as the sole proxy for financial distress is especially troublesome because bankruptcy is a legal, rather than an economic, event. Using a legal event such as bankruptcy as the only proxy for economic conditions may produce misleading results.

Lau (1987) improved research methods applied in financial predictive models by using a five-state response scale to approximate the continuum of corporate financial health. Lau (1987, p. 128) considered these states to be an ordinal scale of financial distress, 'states one to four are states of increasing severity of financial distress'. However, a limitation of Lau's study is that she used a nomi-

Table 1
Selection of Developmental (1988) and Holdout (1989) Samples of Firms

		Sample selection process					
Sample	*States*[1]	*Step 1*[2]	*Step 2*	*Step 3*	*Step 4*	*Totals*	*Percentage of sample*
Developmental: (1988 firms)							
	State 0	241	(64)	(27)	N/A	150	73.529
	State 1	37	(16)	(4)	(1)	16	7.843
	State 2	54	(20)	(12)	(1)	21	10.294
	State 3	59	(34)	(7)	(1)	17	8.334
						204	100.000
Holdout: (1989 firms)							
	State 0	184	(46)	(35)	N/A	103	73.050
	State 1	32	(12)	(6)	(2)	12	8.510
	State 2	62	(32)	(14)	(3)	13	9.220
	State 3	84	(50)	(15)	(6)	13	9.220
						141	100.000

[1] State 0 = healthy firms. State 1 = dividend reduction firms. State 2 = loan default/accommodation firms. State 3 = bankrupt firms.

[2] Step 1: *Compustat* tapes were used to identify firms that, after three years of consistent annual cash dividends per share, reduced their annual cash dividends per share by more than 40% from the previous year for 1988 or 1989. *Compact Disc Disclosure* and *Wall Street Journal Index* were used to identify firms that, during 1988 or 1989, defaulted on loan principal/interest payments, renegotiated loan terms that extended cash payment schedules, reduced interest rates or principal payments or declared bankruptcy. Healthy firms for 1988 and 1989 were randomly selected from *Compustat* tapes. Firms selected were in the same four-digit industry code as a financially distressed firm, but had not been identified as financially distressed during 1988 and 1989.

Step 2: Firms not included in *Compustat* and firms with incomplete data were dropped from the samples.

Step 3: We examined all sample firms' SEC 10-Ks and annual reports (healthy and distressed firms) to validate the occurrence of a financial distress event, the date of the event and other important information. Companies not meeting specific criteria were eliminated from the samples. Firms were dropped if we could not verify the event, or if the date of the event could not be determined. Firms were also dropped from the samples if management was under investigation for fraudulent activities related to the misstatement of financial statement information. Likewise, firms with unreliable data (e.g., firms with unaudited financial statements) were dropped.

Step 4: Firms poorly matched among the last three states of financial distress were dropped.

nal logistic procedure to generate the prediction model; her model did not incorporate the ordinal structure of the dependent variable. For ordinally-scaled dependent variables, ordinal logistic regression models are superior to nominal logistic models (Agresti, 1984; and Kennedy, 1992), and statistical tests similar to those in ordinary least squares regression can be performed.

Ward (1994) extended Lau's multi-state methodology by using ordinal logistic regression to generate the prediction models for a four-state ordinal response scale. This study models the severity of a firm's financial distress by using Ward's four ordinal states of financial distress as the dependent (response) variable and by employing ordinal logistic regression. This study does not include firms that declare bankruptcy and then liquidate as a fifth state of financial distress because the authors identified only four liquidation firms for the developmental sample. The ordinal states of financial distress (dependent variable) used in this study are:

DIST = 0 if firm was healthy (no event of financial distress during 1988 or 1989);
1 if firm experienced a greater than 40% reduction in cash dividend per share during 1988 or 1989 after a history of successive cash dividends per share paid;
2 if firm experienced a loan principal/interest default or debt accommodation (extension of cash payment schedules, reduction in principal, or reduced interest rates) during 1988 or 1989; and
3 if firm filed, or was forced to file, for Chapter XI protection during 1988 or 1989.

The research of Giroux and Wiggins (1984), Lau (1987) and DeAngelo and DeAngelo (1990) supports the use of dividend reduction as the second level of financial distress. Determining a selection criterion for state one firms is obviously arbitrary. We chose a 40% dividend reduction criterion because such a reduction should be large enough to affect stockholders adversely. Lau and Ward also used a 40% criterion to select their dividend reduction firms.

Firms will not necessarily go through all events of financial distress; some firms may default on a loan before cutting dividends or after declaring bankruptcy. However, this possibility should not adversely impact our ordinal variable. To maintain the ordinal scale of financial distress, we assigned the highest level of financial distress observed to companies that experienced more than one financial distress event in the same year. If identified, we also dropped from our samples healthy and dividend reducing firms that incurred loan defaults/accommodations or entered bankruptcy during our data collection period (1985 to 1987 for the 1988 sample and 1986 to 1988 for the 1989 sample). We also dropped from our samples loan default/accommodation firms that first filed for bankruptcy during our data collection period.

Independent (Predictor) Variables

All independent variables were computed from Standard and Poor's *Computstat PC Plus*. This study develops ordinal four-state prediction models containing the following eight control variables and various variables of research interest:

SALESCA = sales/current assets;
CACL = current assets/current liabilities;
OETL = owners' equity/total liabilities or adjusted owners' equity/adjusted total liabilities;
CATA = current assets/total assets or current assets/adjusted total assets;
CASHTA = cash plus marketable securities/total assets or cash plus marketable securities/adjusted total assets;
SIZE = log(total assets) or log(adjusted total assets);
CFFF = cash flow from financing activities/total liabilities or cash flow from financing activities/adjusted total liabilities; and
CFFI = cash flow from investing activities/total liabilities or cash flow from investing activities/adjusted total liabilities.[1]

The first five control variables (scaled by unadjusted measures) are accrual variables used by Casey and Bartczak (1984 and 1985), Gilbert, Menon and Schwartz (1990) and Ward (1994) in prior financial distress studies. (The only major difference is that Casey and Bartczak, and Gilbert, Menon and Schwartz used total liabilities/owners' equity instead of owners' equity/total liabilities.) Ohlson (1980) recommended that all future financial distress studies include a control variable for firm size. Ward included the log(total assets) as a control variable for firm size in his study. CFFI and CFFF variables are based on the statement of cash flows. Neill, Schaefer, Bahnson and Bradbury (1991) recommended that future financial distress studies examine CFFI and CFFF variables.

The variables of research interest are as follows:

NITA = net income/total assets;
DPDTADJ = depreciation and amortisation and deferred tax allocations adjusted operating flow/adjusted total assets;
NQAFLOW = net-quick-assets operating flow/total assets or net-quick-assets flow/adjusted total assets; and[2]
CFFO = cash flow from operating activities/adjusted total assets.[3]

Net income and the operating flow measures were scaled by either total assets or adjusted total assets because prior studies showed that net income/total assets was normally a strong predictor of financial distress.

Adjusted scaling measures are adjusted for the impact of depreciation and amortisation and deferred tax allocations as follows: (1) adjusted total assets = total assets + accumulated depreciation and amortisation; (2) adjusted liabilities = total liabilities − accumulated deferred taxes; and (3) adjusted owners' equity = adjusted total assets − adjusted total liabilities. Data limitations prevented the elimination of all financial accounting allocations from the scaling measures. We found no prior financial distress studies that investigated the impact of allocations in this manner. Prior studies normally scaled predictor variables, especially accrual variables, by traditional balance sheet totals such as total assets, total liabilities, or owners' equity.

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[1] Cash flow from financing activities (CFFF) = increase (decrease) in current debt + increase (decrease) in long-term debt + sale of common and preferred stock − purchase of common and preferred stock − cash dividends. Cash flow from investing activities (CFFI) = sales of property, plant and equipment − capital expenditures − acquisitions − increase in investments + sale of investments.

[2] The net-quick-asset flow reported in this study is not an exact proxy for Thomas's net-quick-assets flow. Because of *Compustat's* data limitations, we were able to adjust only depreciation, deferred tax and inventory effects. Thomas's net-quick-assets flow would also exclude the effects of other non-monetary items such as supplies and prepaid items.

[3] DPDTADJ, NQAFLOW and CFFO were calculated using the following formulas based on *Compustat* line items: depreciation and amortisation and deferred tax allocations adjusted operating flow (DPDTADJ) = income before extraordinary items + depreciation and amortisation + deferred taxes and investment tax credit (decrease); net-quick-assets operating flow (NQAFLOW) = DPDTADJ + equity in net loss (earnings) + loss (gain) from sale of property, plant and equipment and investments + funds from operations-others + decrease (increase) in inventory; and cash flow from operating activities (CFFO) = NQAFLOW + decrease (increase) in accounts receivable + decrease (increase) in other current assets + increase (decrease) in current liabilities other than current debt. The *Compustat* line item depreciation and amortisation includes annual depletion expense. Before 1987, loss (gain) from sale of property, plant and equipment and investments is included in funds from operations-others.

Ordinal Four-state Logistic Regression Model

Firms used to generate the ordinal four-state regression models were not pooled across many years but were all selected from one year, 1988 (developmental sample). This study uses financial data for 1984/85 (year three models), 1985/86 (year two models), and 1986/87 (year one models) to generate financial distress regression models from the developmental sample of 1988 firms.

The financial distress regression models were constructed using ordinal logistic regression (OLGR). This study employed proportional odds OLGR models (see, for example, Agresti, 1984 for a discussion of various ordinal logistic regression models). This procedure fits a parallel lines regression model based on transformed cumulative logits. Suppose the reponse variable can take on the ordered values 0, 1, 2 and 3 with p predictor variables. Defining CP_i as the cumulative probability that a firm is in state i or lower given the vector $\mathbf{X} = (X_1, X_2, \ldots, X_p)$ of independent variables, the cumulative logit (CL_i) can be estimated as follows:

$$CL_i = \ln\,[CP_i/(1\text{-}CP_i)] = a_i + b_1X_1 + b_2X_2 + \ldots + b_pX_p, \qquad (1)$$

where $i = 0$ to 2.
Then:

$$CP_i = P(DIST \leq i|X) = \frac{\exp^{(CLi)}}{1 + \exp^{(CLi)}}, \qquad (2)$$

where CP_i = the cumulative probability; DIST = financial distress with levels 0 to 3 (0 = healthy, 1 = dividend reduction, 2 = loan default/accommodation and 3 = bankruptcy); a_i ($i = 0$ to 2) are intercept parameters; and the b_{w} coefficients represent the effect of the *w*th explanatory variable on a firm's probability of ending up in state *i* or lower.[4]

With the response variable taking on the ordered values 0 to 3, the conditional probability that the *j*th observation has response *i* is given by:

$$P(DIST = 0|X_j) = CP_0 \qquad (3)$$

$$P(DIST = 1|X_j) = CP_1\text{-}CP_0 \qquad (4)$$

$$P(DIST = 2|X_j) = CP_2\text{-}CP_1 \qquad (5)$$

$$P(DIST = 3|X_j) = 1\text{-}CP_2, \qquad (6)$$

where $\mathbf{X}_j$ is the known vestor of predictor variables corresponding to the *j*th observation.

OLGR assumes an ordinal relationship between the dependent and independent variables. Like ordinary least squares regression, ordinal logistic regression generates only one parameter estimate and one test statistic for each predictor variable (no matter the number of levels of the dependent variable). OLGR additionally allows the intercepts (intervals) to vary between the states of distress to incorporate the differing impacts of predictor variables across the multi-state levels.

Because financial distress studies use non-random techniques to select bankrupt and non-bankrupt firms, researchers often argue that binary probit (e.g., Zmijewski, 1984) and binary conditional logistic (e.g., Cosslett, 1981) models generate biased parameter estimates. However, Maddala (1991) distinguishes the binary logit model used by previous bankruptcy researchers from the binary conditional logistic model. According to Maddala, a weighting procedure is not needed for a binary logit model because the predictor variables' coefficients are not influenced by unequal sampling rates for the bankrupt and non-bankrupt groups; only the constant term is affected. We are unaware of research addressing this issue for ordinal multi-state logistic regression models.

Empirical results

Model with NQAFLOW Added to Control Variables

To determine the incremental explanatory power of Thomas's net-quick-assets operating flow (NQAFLOW), this study first fits a model including NQAFLOW and the eight control variables. Independent variables were calculated using unadjusted scaling measures. Models were generated from data for the developmental sample of 1988 firms lagged one, two and three years before the event of financial distress.

Panel A of Table 2 presents the expected signs of the parameter estimates, parameter estimates, and Wald chi-square statistics' p-values for the variables in the model. They show that NQAFLOW is the dominant predictor of financial distress one year before the event. However, NQAFLOW is not significant two or three years before financial distress. The signs for the parameter estimates are generally as expected. The sign of NQAFLOW's parameter estimate suggests that financially distressed firms are more likely to have a lower net-quick-assets-flow one year before financial distress than healthy firms.

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[4] The negative of the cumulative logits provides cumulative probabilities that a firm is in a given state of financial distress or higher, $1\text{–}CP_i$. For simplicity's sake, reported results are from the negative cumulative logits; thus, the parameter estimates' signs (slopes) are in the logical direction, from lowest to highest state of financial distress.

The results also show the SALESCA is a significant predictor of financial distress every year, while OETL, CATA, SIZE and CFFI are significant two out of three years (at p-value <0.10). The sign on CFFI indicates that financially distressed firms are more likely to have inflows from investing activities than healthy firms one and two years before financial distress. The significance of CFFI is especially interesting, since previous financial distress studies have found limited explanatory power for cash flow based ratios.

The significance of OETL is also interesting. Casey and Bartczak (1985, p. 396) used total liabilities/owners' equity (TLOE) as a predictor variable instead of OETL. They did not find TLOE to be significant in any five years preceding financial distress. In this study, we first ran all models using TLOE instead of OETL. Because OETL outpredicted TLOE every year, we report the results for models that include OETL. An analysis of our data suggested that the reason for TLOE's weak explanatory power is that many loan default/accommodation and bankrupt firms have negative owners' equity in periods prior to the distress event. For firms with negative owners' equity, TLOE's statistical impact is to label these firms as very healthy. This result suggests that financial distress researchers should consider using OETL instead of TLOE to prevent this scaling inconsistency.

Many of the above model's predictor variables include traditional balance sheet totals as scaling measures. The use of allocation-adjusted scaling measures (as free of large accounting allocations as possible) should better address the usefulness of depreciation and amortisation and deferred tax allocations. Thus, we re-ran the above model including NQAFLOW after eliminating the effects of depreciation and amortisation and deferred tax allocations from the scaling measures and compared results. (The following variables' scaling measures were adjusted: OETL, CATA, CASHTA, SIZE, CFFF, CFFI and NQAFLOW.)

Panel B of Table 2 reports the results for this adjusted model. The adjusted model's results suggest that depreciation and amortisation and deferred tax allocations may limit the predictive usefulness of accounting information. In every year, the adjusted model's -2Log Likelihood statistic is much larger than the unadjusted model's -2Log Likelihood statistic. The differences are surprisingly large considering that the models differ only in the calculation of the scaling measures. Because both models have the same degrees of freedom, the significance of the increase in the -2Log Likelihood chi-square cannot be determined. (For illustrative purposes only, if the addition of one independent variable to the model has caused the increase in the -2Log Likelihood chi-square, then the increase in the -2Log Likelihood chi-square would be significant every year at a p-value <0.05.)

The Wald chi-square p-values also decreased for most of the adjusted predictor variables. For example, NQAFLOW is now significant one and two years before financial distress (at p-value <0.05). CFFF is now significant one and three years before financial distress (at p-value <0.1). OETL and CATA are now significant one, two and three years before financial distress (at p-value <0.1).

Comparison of Various Models

We next compared the incremental explanatory power of NQAFLOW with two additional operating flow variables, DPDTADJ and CFFO, and a net income variable (NITA).[5] We examined DPDTADJ because Thomas was especially critical of major financial accounting allocations across time. We compared the statistical results for the NQAFLOW and DPDTADJ models to the CFFO and NITA models because the Financial Accounting Standards Board (FASB) currently requires firms to provide both an income statement and a statement of cash flows. Thus, current generally accepted accounting principles assume that these two extreme measures (cash flow and full allocated accrual income) of operating performance provide useful information to financial statement users.

NQAFLOW, DPDTADJ, CFFO and NITA were each incorporated separately in a model including the eight control variables. Because NQAFLOW, DPDTADJ and CFFO are free of depreciation and amortisation and deferred tax allocations, the relevant variables in these three models (DIST=control variables+NQAFLOW, DPDTADJ, or CFFO) were scaled by adjusted scaling measures. The income model's (DIST=control variables+NITA) variables were scaled by unadjusted scaling measures. Thus, the NITA model's variables are based on traditional financial statement items. Adjusted scaling measures for the NQAFLOW, DPDTADJ and CFFO model's variables more closely approximate variables that would result from statements advocated by Thomas. Therefore, comparing results from these models should provide a better test of Tho-

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[5] To simplify discussions of the various models, we identify each financial distress model by the operating flow or income variable included in each model. Thus, the: (1) DPDTADJ model is DIST=control variables + DPDTADJ; (2) NQAFLOW model is DIST=control variables + NQAFLOW; (3) CFFO model is: DIST=control variables + CFFO; (4) NITA model is: DIST=control variables + NITA.

Table 2
Unadjusted and Adjusted Models With NQAFLOW Added to Control Variables

Model[1]	*Variables*	*Expected sign*	*Year-1 Parameter estimated*	*P-values*[2]	*Year-2 Parameter estimates*	*P-values*	*Year-3 Parameter estimate*	*P-values*
Panel A, Unadjusted model:								
	Intercept 1		2.2291	0.015	3.4848	0.0002	2.4423	0.007
	Intercept 2		1.3424	0.137	2.7929	0.002	1.8969	0.037
	Intercept 3		−0.2441	0.789	1.5011	0.104	0.8483	0.354
	SALESCA	(−)	−0.1850	0.072	−0.2250	0.026	−0.2056	0.032
	CACL	(−)	−0.2025	0.455	−0.3679	0.191	0.0823	0.701
	OETL	(−)	−0.9570	0.018	−0.4968	0.138	−0.4050	0.091
	CATA	(−)	−1.4763	0.118	−1.5185	0.088	−1.7339	0.051
	CASHTA	(−)	−2.5936	0.494	−3.7451	0.145	−2.4786	0.217
	SIZE	(−)	−0.0094	0.928	−0.1826	0.068	−0.2361	0.016
	CFFF	(−)	−0.9737	0.212	0.9090	0.220	−0.4530	0.206
	CFFI	(+)	2.4610	0.052	3.5107	0.008	0.7707	0.197
	NQAFLOW	(−)	−8.0433	0.0001	−1.8722	0.198	−1.0050	0.245
−2Log Likelihood			109.467***		73.697***		30.873***	
Panel B, Adjusted model:								
	Intercept 1		2.9128	0.002	3.4937	0.0003	0.6472	0.003
	Intercept 2		2.0121	0.036	2.7817	0.003	2.0880	0.021
	Intercept 3		0.3821	0.689	1.4579	0.118	1.0250	0.260
	SALESCA	(−)	−0.1924	0.062	−0.2117	0.035	−0.1999	0.037
	CACL	(−)	−0.1620	0.547	−0.3285	0.238	0.1439	0.483
	OETL	(−)	−0.6902	0.003	−0.4204	0.046	−0.4371	0.007
	CATA	(−)	−2.5193	0.026	−1.9181	0.062	−2.2500	0.025
	CASHTA	(−)	−2.1627	0.631	−2.8977	0.330	−1.8773	0.392
	SIZE	(−)	−0.0432	0.680	−0.1668	0.092	−0.2363	0.014
	CFFF	(−)	−1.4959	0.076	0.3219	0.679	−0.6708	0.087
	CFFI	(+)	2.4753	0.050	2.7742	0.035	0.3393	0.554
	NQAFLOW	(−)	−11.1363	0.0001	−3.8406	0.048	−1.0084	0.334
−2Log Likelihood			115.749***		79.644***		35.436***	

[1] The unadjusted model's variables were calculated using unadjusted scaling measures, while the adjusted model's variables were calculated using adjusted scaling measures (adjusted total assets = total assets + accumulated depreciation and amortisation, adjusted total liabilities = total liabilities − accumulated deferred tax, and adjusted owners' equity = adjusted total assets − adjusted total liabilities). SALESCA = sales/current assets, CACL = current assets/current liabilities, OETL = owners' equity/total liabilities or adjusted owners' equity/adjusted total liabilities, CATA = current assets/total assets or current assets/adjusted total assets, CASHTA = cash plus marketable securities/total assets or cash plus marketable securities/adjusted total assets, SIZE = log (total assets) or log (adjusted total assets), CFFF = cash flow from financing activities/total liabilities or cash flow from financing activities/adjusted total liabilities, CFFI = cash flow from financing activities/total liabilities or cash flow from financing activities/adjusted total liabilities, and NQAFLOW = net-quick-assets operating flow/total assets or net-quick-assets flow/adjusted total assets.

[2] P-value of the Wald chi-square statistic for each parameter estimate.

[3] −2Log Likelihood—distributed as a chi-square distribution with nine degrees of freedom. This statistic tests the null hypothesis that all nine predictor variables in the model are zero.

***Significant at p-value <0.01.

mas's assertions that allocations do not represent economic reality.

Table 3 reports the Wald chi-square for each variable of interest and the −2Log Likelihood chi-square for every model. The Wald chi-square measures the significance of each individual variable of interest, while the −2Log Likelihood chi-square measures the explanatory power of the overall model. Individually, an operating flow variable may not be more important than traditional net income, but the operating flow model may still be more powerful than the income model because the two large allocations are eliminated from the scaling measures.

The models' −2Log Likelihood statistics show that the NITA model fails to outpredict any of the operating flow models one, two, or three years before financial distress. (The −2Log Likelihood chi-square is always larger for each operating flow model). NITA is significant one year before finan-

Table 3
Comparison of NQAFLOW, DPDTADJ, CFFO and NITA Ordinal Four-State Models

	Year-1		*Year-2*		*Year-3*	
Model[1]	*Wald* χ^2	*−2Log L*	*Wald* χ^2	*−2Log L*	*Wald* χ^2	*−Log L*
NITA	9.99**	103.27	0.65	72.49	0.83	30.12
DPDTADJ	15.70**	118.46	4.09**	79.74	1.71	36.35
NQAFLOW	17.84**	115.74	3.90**	79.64	0.97	35.43
CFFO	9.42**	104.78	7.88**	84.13	0.76	35.20

[1] NITA model: DIST = control variables + NITA. DPDTADJ model: DIST = control variables + DPDTADJ. NQAFLOW model: DIST = control variables + NQAFLOW. CFFO model: DIST = control variables + CFFO. DIST = 0 if firm was healthy during 1988 or 1989; 1 if firm experienced a greater than 40% reduction in cash dividend per share during 1988 or 1989 after a history of successive cash dividends per share paid; 2 if firm experienced a loan principal/interest default or debt accommodation during 1988 or 1989; and 3 if firm filed, or was forced to file, for Chapter XI protection during 1988 or 1989.
The NITA model's variables were calculated using scaling measures (total assets, total liabilities and owners' equity) as reported on published financial statements, unadjusted for depreciation and amortisation and deferred tax allocations. The DPDTADJ, NQAFLOW and CFFO models' variables (accrual ratios and flows) were calculated using adjusted scaling measures (adjusted total assets = total assets + accumulated depreciation and amortisation, adjusted total liabilities = total liabilities − accumulated deferred tax, and adjusted owners' equity = adjusted total assets − adjusted total liabilities). NITA = net income/total assets, DPDTADJ = depreciation and amortisation and deferred tax adjusted operating flow/adjusted total assets, NQAFLOW = net-quick-assets operating flow/adjusted total assets, and CFFO = cash flow from operating activities/adjusted total assets. The remaining control variables are defined in Table 2.
The Wald χ^2 (chi-square distribution with one degree of freedom) tests the predictive significance of each individual flow or income variable, while the −2Log L (chi-square distribution with nine degrees of freedom) tests the predictive significance of the overall model.
**Significant at p-value <0.05
The −2 Log Likelihood was significant every year for all models at p-value <0.01.

cial distress only. NQAFLOW, DPDTADJ and CFFO are all significant predictors of financial distress (based on Wald chi-squares) one and two years before financial distress (at p-value <0.05), NQAFLOW and DPDTADJ are more significant than NITA every year. Both NQAFLOW and DPDTADJ are more significant than CFFO one and three years before financial distress, but CFFO is the most significant variable two years before financial distress.[6]

Analysis of Operating Flow Component Variables

The following individual component variables were also tested to help explain differences in the significance of the operating flow and income variables.

DEPRE = depreciation and amortisation expense/adjusted total assets;
DT = deferred taxes and investment tax credit/adjusted total assets;
LOSS = (equity in net loss+loss from sale of property, plant and equipment and investments+funds from operations-others)/adjusted total assets;
CHGINV = decrease (increase) in inventory/adjusted total assets;
CHGAREC = decrease (increase) in accounts receivable/adjusted total assets;
CHGOCA = decrease (increase) in other current assets/adjusted total assets; and
CHGCLO = increase (increase) in curent liabilities other than debt/adjusted total assets.

Each component variable was added separately to a model that included the eight control variables and CFFO. The adjusted scaling measures were used to calculate this model's relevant variables. CFFO was included in the model because it represents a base operating flow variable free of all allocations and accrual effects. If a component is important in predicting financial distress, then the component variable should have incremental explanatory power when included in a model with CFFO. We do not report results for one full model including all component variables because of severe collinearity among the parameter estimates for the components and CFFO.

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[6] A review of each model's parameter estimates' correlations indicated no collinearity problem in any of the flow or income models.

The Change in −2Log Likelihood was used to test the incremental explanatory power of each component variable. In situations where collinearity exists, the Wald chi-square statistic for each parameter estimate is not the best measure of an added variable's explanatory power. Instead, the preferred measure is the change in the overall model's log likelihood statistic when a variable is added (see, for example, Hosmer and Lemeshow 1989, pp. 11-18 and pp. 223-226, for a discussion of this topic). The Change in −2Log Likelihood follows a chi-square distribution and is comparable to a partial F test in ordinary least squares regression.

Table 4 presents the −2Log Likelihood chi-square for the base model (DIST=control variables+CFFO), −2Log Likelihood chi-square for the models with each component variable added separately to the base model, and the Change in −2Log Likelihood chi-square from adding each component variable. The results show that depreciation and deferred tax components are not significant (at p-value <0.1) in any year. The Change in −2Log Likelihood also shows that CHGAREC and CHGOCA are significant predictors of financial distress one year before financial distress, while CHGCLO is significant two years before financial distress. CHGAREC is also somewhat significant three years before financial distress.

The sign on each operating flow component variable's parameter estimate suggests that: (1) the larger the decrease in other current assets (CHGOCA), the greater the likelihood that the firm will be distressed one year later; (2) the larger the decrease in accounts receivable (CHGAREC), the greater the likelihood a firm will be financially distressed one or three years later; and (3) firms significantly decreasing current liabilities other than debt (CHGCLO) were more likely to be financially distressed two years later.

The sign of CHGCLO may appear counter-intuitive. However, a review of the short-term and long-term components that make up cash flow from financing activities (CFFF) provided insight concerning why financially distressed companies might decrease current liabilities other than current debt two years before the distress event. This review suggested that distress firms were using short-term debt funds to cover long-term liabilities. (Distressed firms tended to have short-term financing inflows two years before financial distress).

The results for the operating flow components are substantially consistent with Thomas's theory and help explain the differences in the results for the models reported in Table 3. The insignificance of the depreciation and deferred tax components helps explain why NQAFLOW, DPDTADJ and CFFO outpredict NITA every year before financial distress. This result is consistent with Thomas's criticism of major financial allocations across time. The significance of CHGAREC and CHGOCA in year one and CHGCLO in year two is consistent with Thomas's belief that changes in monetary accounts are useful. However, the results show that most of the usefulness of the monetary accounts may be short-run, primarily one year before financial distress. These results explain why the NQAFLOW model was the strongest explanatory model in year-1 only (Table 3).

Results for the flow component variables indicate one major contradiction to Thomas's theory. The change in inventory (CHGINV), a non-monetary item, is a strong predictor of financial distress one year before the event. The sign of CHGINV's parameter estimate suggests that the larger the decrease in inventory, the more likely a firm will be financially distressed one year later. The finding is consistent with results reported by Laitinen.

Finding predictive significance for CHGAREC one year before financial distress is consistent with the results reported by Gentry, Newbold and Whitford (1987). However, they did not show incremental explanatory power for other changes in assets/liabilities. A possible reason why this study finds statistical significance for other operating components is that our sample size is much larger than the sample used by these researchers. Simulation studies (e.g., Stone and Rasp, 1991) have shown that total sample sizes of less than 10(S+1), where S is the number of predictor variables in the model, lead to conservatively biased parameter estimates in binary logistic prediction models. Because Gentry, Newbold and Whitford included from 12 to 20 predictor variables in their models, the results were possibly biased by their small sample size of 66 firms (33 bankrupt and 33 non-bankrupt).

Validation of Statistical Results—RPSs

The statistical results from the developmental sample are validated using a separate holdout sample of 1989 firms. The parameter estimates generated by the regression models from the 1988 developmental sample are applied to the separate holdout sample of 1989 firms, thus providing cross-sample and intertemporal validation (Lau, 1987). Conditional probabilities are obtained for each state of financial distress for each firm. Then the rank probability score rule (hereafter RPS) and classification accuracy rates are used to assess each model's predictive strength. RPS was proposed by Epstein (1969) and incorporated by Lau (1987) and Ward (1994). RPS normally provides a better measure of an ordinal multi-state model's predic-

Table 4
The Addition of Each Component Variable Separately to a Base Model Including the Control Variables and CFFO

Year	*Component*[1] *variable added*	*Observed sign of parameter estimate*	*−2Log L*[2] *(base)*	*−2Log L*[3] *(added)*	*Change in*[4] *−2Log L*	*Degrees of freedom*	*P-value*
Year-1			104.782				
	DEPRE	(−)		105.353	0.571	1	0.499
	DT	(−)		105.537	0.755	1	0.384
	LOSS	(+)		104.901	0.119	1	0.730
	CHGINV	(+)		114.433	9.651	1	0.001
	CHGAREC	(+)		110.129	5.347	1	0.020
	CHGOCA	(+)		110.339	5.557	1	0.018
	CHGCLO	(+)		105.418	0.636	1	0.425
Year-2			84.136				
	DEPRE	(−)		84.204	0.068	1	0.794
	DT	(−)		86.554	2.418	1	0.119
	LOSS	(−)		84.141	0.005	1	0.943
	CHGINV	(−)		84.191	0.055	1	0.814
	CHGAREC	(+)		86.612	2.476	1	0.115
	CHGOCA	(+)		84.578	0.442	1	0.506
	CHGCLO	(−)		87.772	3.636	1	0.056
Year-3			35.208				
	DEPRE	(−)		35.384	0.176	1	0.674
	DT	(+)		35.649	0.441	1	0.506
	LOSS	(+)		37.000	1.792	1	0.180
	CHGINV	(−)		35.391	0.183	1	0.668
	CHGAREC	(+)		38.371	3.163	1	0.075
	CHGOCA	(−)		36.628	1.420	1	0.230
	CHGCLO	(−)		36.646	1.438	1	0.230

[1] CFFO = cash flow from operating activities/adjusted total assets; DEPRE = depreciation and amortisation/adjusted total assets; DT = deferred tax expense and investment tax credit/adjusted total assets; LOSS = (equity in net loss + loss from sale of property, plant and equipment and investments+funds from operations-others)/adjusted total assets; CHGINV = decrease (increase) in inventory/adjusted total assets; CHGAREC = decrease (increase) in accounts receivable/adjusted total assets; CHGOCA = decrease (increase) in other current assets/adjusted total assets; and CHGCLO = increase (decrease) in current liabilities other than debt/adjusted total assets. The remaining control variables are defined in Table 2, using the adjusted scaling measures.

[2] −2Log Likelihood for the base model: DIST = control variables + CFFO—exhibits a chi-square distribution with nine degrees of freedom.

[3] −2Log Likelihood for each model with a fund component variable added to the base model—exhibits a chi-square distribution with 10 degrees of freedom.

[4] Change in −2Log Likelihood—the change in the −2 Log Likelihood statistic from the base to added models—exhibits a chi-square distribution with one degree of freedom. A significant Change in −2Log Likelihood chi-square indicates that the component variable has incremental predicitve usefulness.

tive power than classification accuracy, because RPS considers the rank of the ordinal dependent variable and the continuous probabilities generated by an ordinal model. Also, RPS does not require arbitrary cut-offs (as required when using classification accuracy) to test a model's predictive power.

Financial distress prediction models should outpredict a naive chance model to be of practical use. Therefore, like Lau, this study also compares model's RPSs for the holdout sample to the RPS calculated using a naive model. A chance naive model would provide, for each observation, state conditional probabilities of distress equal to the holdout sample's proportions. Thus, a naive model (with states 0 = healthy, 1 = dividend reduction, 2 = loan default/accommodation and 3 = bankruptcy) would provide a vector of probabilities equalling [0.7305, 0.0851, 0.0922, 0.0922] for each firm in the holdout sample. This vector of probabilities was also used as the cut-off points for classification purposes.

Table 5
Rank Probability Scores (RPSs) and Classification Rates for Four-State Ordinal Logistic Regression Models

	RPS scores[1]				*Percentage of firms classified correctly*		
Model[3]	*Year-1*	*Year-2*	*Year-3*	*Naive*[2]	*Year-1* %	*Year-2* %	*Year-3* %
NITA:							
Overall score	125.594	124.547	121.815	120.740	63.31	57.45	53.19
State 0	99.287	99.228	98.446		77.67	70.87	66.02
State 1	9.231	9.416	9.724		8.33	0.00	0.00
State 2	10.133	9.685	9.251		7.69	38.46	46.15
State 3	6.943	6.226	4.394		53.85	23.08	7.69
DPDTADJ:							
Overall score	125.774	126.336	123.084	120.740	70.92	64.54	56.74
State 0	98.445	99.546	99.055		80.58	74.76	67.96
State 1	9.249	9.497	9.807		41.67	33.33	8.33
State 2	11.195	10.345	9.491		61.54	53.85	46.15
State 3	6.885	6.948	4.731		30.77	23.08	15.38
NQAFLOW:							
Overall score	124.382	125.529	123.118	120.740	69.50	61.70	51.06
State 0	99.544	99.600	98.888		79.61	72.82	64.08
State 1	9.374	9.566	9.834		66.67	0.00	0.00
State 2	11.295	10.703	9.626		46.15	84.61	38.46
State 3	4.169	5.660	4.770		15.38	7.69	7.69
CFFO:							
Overall score	125.249	125.564	123.098	120.744	65.96	60.28	53.90
State 0	100.084	99.034	98.782		80.58	72.62	67.96
State 1	9.321	9.575	9.824		33.33	25.00	8.33
State 2	10.681	10.024	9.661		23.08	30.77	30.77
State 3	5.163	6.931	4.831		23.08	23.08	7.69

[1] The ordinal state models were generated with DIST = state 0 (healthy firms), state 1 (dividend reduction firms), state 2 (loan default/accommodation firms) and state 3 (bankrupt firms). The ordinal three-state models were generated with DIST = state 0 (healthy firms), state 1 (dividend reduction firms) and state 2 (loan default/accommodation and bankrupt firms).

[2] The highest possible score for each model equals the number of firms in the sample. Total sample size equals 141 firms. The sample sizes by state of distress are: state 0 = 103 firms, state 1 = 12 firms, state 2 = 13 firms and state 3 = 13 firms. A chance naive model would provide for each observation state conditional probabilities of distress equal to the holdout sample's proportions. Thus, a naive four-state model would provide a vector of probabilities equaling [0.7305, 0.0851, 0.0922, 0.0922] for each firm in the holdout sample. These probabilities were used to obtain a naive RPS score for the four-state models. The sample proportions were also used as cutoffs for classifying each firm.

[3] NITA model: DIST = control variables + NITA. DPDTADJ model: DIST = control variables + = DPDTADJ. NQAFLOW model: DIST = control variables + NQAFLOW. CFFO model: DIST-control variables + CFFO. Variables are defined in Table 3.

Table 5 presents the models' RPSs and classification rates for the holdout sample. The RPSs show that all distress models outperform the naive predictive model each year. Both RPSs and classification rates show that the DPDTADJ distress model is the strongest prediction model one and two years before financial distress. The RPSs show that the NQAFLOW model is the strongest prediction model in year-3, while classification rates show that DPDTADJ is the strongest model in year-3. The DPDTADJ distress model outpredicts the income model (NITA) every year for both RPS scores and classification rates.

The RPSs and classification rates for each state of distress show that all models tended to predict the healthy and loan default/accommodation firms the best. All models had difficulty predicting the bankrupt firms (state three); however, the NITA model predicted bankruptcy a good year before the events.

Overall, prediction results for the holdout sample primarily agree with the developmental sample's statistical results reported earlier. Depreciation and amortisation and deferred tax allocations seem to limit the predictive usefulness of net income (as evident by the DPDTADJ model outpredicting the NITA model every year). Surprisingly, when using RPSs, the predictive usefulness of

Table 6
Means for Net Income and Operating Flow Variables

Variable*	Original sample of 1988 firms				Holdout sample of 1989 firms			
	State 0	*State 1*	*State 2*	*State 3*	*State 0*	*State 1*	*State 2*	*State 3*
Year-1:								
NITA	0.038	−0.023	−0.338	−0.349	0.032	−0.059	−0.285	−0.211
DPDTADJ	0.074	0.032	−0.097	−0.216	0.075	0.007	−0.085	−0.146
NQAFLOW	0.066	0.015	−0.085	−0.085	0.070	−0.014	−0.085	−0.011
CFFO	0.067	−0.003	−0.078	−0.032	0.079	−0.017	−0.018	−0.002
Year-2								
NITA	0.036	0.015	−0.363	−0.163	0.041	0.027	−0.164	−0.243
DPDTADJ	0.081	0.050	−0.165	−0.083	0.074	0.068	−0.098	−0.168
NQAFLOW	0.074	0.036	−0.085	−0.093	0.060	0.046	−0.134	−0.088
CFFO	0.078	0.040	−0.051	−0.104	0.060	0.034	−0.094	−0.038
Year-3								
NITA	0.040	0.023	−0.199	0.009	0.008	0.043	−0.068	−0.011
DPDTADJ	0.085	0.064	−0.089	0.042	0.061	0.085	−0.067	0.019
NQAFLOW	0.083	0.099	−0.053	0.019	0.063	0.070	−0.116	0.024
CFFO	0.081	0.075	−0.053	0.045	0.049	0.082	−0.119	0.004

*Variables are defined in Table 3

DPDTADJ, NQAFLOW and CFFO over the NITA model seems to strengthen the longer the lag before financial distress.[7]

Table 5 results do indicate a difference between the RPSs for holdout firms and the statistical results reported earlier for the developmental models (Table 3). The NQAFLOW, DPDTADJ and CFFO models show an increase in RPSs from one to two years before distress. The NITA model did not exhibit this pattern. Thus, for year-1, only the DPDTADJ distress model outpredicts the NITA model.[8]

Methodology Issue – Validation of Ordinal Scale

A review of the RPSs generated for each firm indicated that the ordinal four-state prediction models had difficulty distinguishing between loan default/accommodation and bankrupt firms, especially three years before the event. In order to determine whether or not the assumption of an ordinal relationship between the response variable (events) and the independent variable was appropriate, the authors investigated the means of the independent variables across the levels of the response variable.

Table 6 shows the means for the operating flow variables and NITA. The means suggest that the ordinal assumption is appropriate for all states of distress except the bankruptcy state (state 0). The means for all variables decrease across states 0, 1 and 2, thus indicating that distressed firms have lower operating flows and net income than healthy firms one, two and three years before financial distress. However, the means do not decrease from states 2 to 3. The bankrupt firms, as a group, do not appear more financially distressed than the loan default/accommodation firms, especially three years before an event. This finding is something of a surprise, since previous multi-state researchers normally scaled bankruptcy higher than loan default/accommodation, with bankruptcy often scaled as the highest state of distress.

To determine whether or not the similarity of loan default/accommodation and bankrupt firms across the independent variables affected the results from the four-state models, we combined the bankrupt firms with the loan default/accommodation firms, thus creating an ordinal three-state response variable. (The loan default/accommodation and bankrupt firms were all coded as state two firms.) Then, we re-ran all models using the ordinal three-state dependent variable. Table 7 contains the statistical results for the ordinal three-state models generated from the developmental sample (1988 firms), while Table 8 contains the RPSs and classification rates from applying the developmental models' parameter estimates to the holdout sample.

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[7] We used the RPSs for the holdout sample simply to validate the statistical results reported earlier for the developmental sample. In this context, the RPS results primarily validate the statistical results for the developmental sample, especially for depreciation and amortisation and deferred tax allocations. We are unaware of significance tests for RPSs.

[8] We reviewed each firm's contribution to the total RPSs (for all models) in year-1 and year-2 to identify any outliers that could cause this unusual result. The review identified two healthy firms, Reflectone Inc. and Royal Gold Mining Company. NQAFLOW, DPDTADJ and CFFO models incorrectly classified these two healthy firms as very distressed one year before 1989, while the NITA model classified Royal Gold Mining Company correctly and misclassified Reflectone Inc. less severely. However, all the models' predictions basically agreed in years-2 and -3. We reviewed these two companies' annual reports and SEC 10-Ks for 1988 and 1989 to investigate why the NQAFLOW, DPDTADJ and CFFO models misclassified them one year before 1989 but properly classified them two years before 1989. The annual reports and SEC 10-Ks revealed that both companies experienced severe economic pressures/events during 1988 that weakened the financial stability of each company. The downturn in economic conditions for both firms continued in 1989, leading auditors for both companies to issue going concern opinions in 1989. Thus, the NQAFLOW, DPDTADJ and CFFO models appeared more sensitive to the downturn in the economic conditions of these two firms than the NITA model.

The statistical results in Table 7 show that the ordinal three-state models do fit the data better (higher −2Log Likelihood statistics and more significant predictor variables) than four-state models. However, the ordinal three-state models still produce results similar to those reported earlier for the four-state models. The NQAFLOW model is the strongest model one year before the event, while the DPDTADJ model is strongest two and three years before the event. DPDTADJ is now significant every year when a three-state response is used. However, none of the operating variables was significant when lagged three years before financial distress for the four-state models (Table 3).

Table 8 results show that either the DPDTADJ model or NQAFLOW model is the best prediction model every year. The allocation-adjusted models especially dominate the NITA model three years before the event. Thus, RPS and classification accuracy results for the three-state models are similar to the four-state results reported earlier.[9]

Conclusions

This study produced many interesting findings. From a methodological standpoint, our results suggest that future researchers consider owners' equity/total liabilities instead of total liabilities/owners' equity as a control variable. Likewise, our findings confirm prior cash flow theorists' contentions that investing cash flows are an important predictor of financial distress (one and two years before the distress event in this study). Thus, future studies should also control for investing flows.

In a predictive usefulness context, our findings substantially, but not completely, support Thomas's (1969, 1974 and 1975) theoretical attack on incorporating large allocations across time, such as depreciation and amortisation and deferred taxes, in financial accounting. Our study's results suggest that depreciation and amortisation and deferred tax accounting allocations may not be useful in predicting financial distress. Thomas advocated using accrual-based funds statements as alternatives to an income statement (preferably a net-quick-assets funds statement). While we found

Table 7
−2Log L for NQAFLOW, DPDTADJ, CFFO and NITA Ordinal Three-State Models

	Year-1		Year-2		Year-3	
Model[1]	*Wald* χ^2	*−2Log L*	*Wald* χ^2	*−Log L*	*Wald* χ^2	*−2Log L*
NITA	12.010*	126.134	11.594*	97.010	3.131	37.48
DPDTADJ	12.513*	127.030	18.180*	107.400	5.507**	46.48
NQAFLOW	16.242*	132.080	10.209*	98.268	3.271	43.43
CFFO	10.613*	123.756	12.469*	101.620	2.748	42.98

[1] All models are the same as defined in Table 3, except all independent variables were regressed on an ordinal three-state response variable. Healthy firms were coded 0. Dividend reduction firms were coded 1. Loan default/accommodation and bankrupt firms were coded 2.
*Significant at p-value <0.01
**Significant at p-value <0.05
The −2Log Likelihood was significant every year for all models at p-value <0.01

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[9] The authors also replicated all tests with models generated by nominal logistic regression. Test results from nominal logistic regression models did not differ substantially from those reported for the four-state and three-state ordinal logistic regression models. However, for the nominal logistic regression models, maximum likelihood estimators often failed to converge for some predictor variables, failing to provide individual test statistics for these variables.

Table 8
RPSs and Classification Rates for Three-State Ordinal Logistic Regression Models

	RPS scores[1]				*Percentage of firms classified correctly*		
Models[2]	*Year-1*	*Year-2*	*Year-3*	*Naive*	*Year-1* %	*Year-2* %	*Year-3* %
NITA							
Overall rate	122.665	122.750	114.992	116.517	75.18	69.50	41.14
State 0	95.163	97.480	98.305		79.61	78.64	48.54
State 1	8.356	8.104	8.905		58.33	16.67	66.67
State 2	19.146	17.166	7.782		65.38	57.69	0.00
DPDTADJ							
Overall rate	124.172	123.889	119.670		75.87	73.76	61.70
State 0	95.830	96.606	96.236		82.53	81.55	67.96
State 1	8.477	8.293	8,675		41.67	33.33	0.00
State 2	19.865	18.880	14.759		65.38	61.54	65.38
NQAFLOW							
Overall rate	122.626	124.323	120.067		79.43	70.92	63.12
State 0	96.653	97.439	96.342		81.55	75.73	66.02
State 1	8.592	8.411	8.781		33.33	25.00	16.67
State 2	17.381	18.473	14.944		52.84	73.07	73.07
CFFO							
Overall rate	123.376	123.199	119.927		73.05	70.92	63.12
State 0	97.761	95.788	96.023		84.47	73.79	68.93
State 1	8.470	8.555	8.750		25.00	50.00	16.67
State 2	17.145	18.865	15.154		50.00	69.20	61.54

[1] The ordinal three-state models were generated with DIST = state 0 (healthy firms), state 1 (dividend reduction firms), state 2 (loan default/accommodation and bankrupt firms). The sample sizes are the same for the three-state models, except that state 2, the final state, equals 26 firms. A naive three-state model would provide a vector of probabilities equalling [0.7305, 0.0851, 0.1844] for each firm in the holdout sample. The sample proportions were also used as cutoffs for classifying each firm.

[2] NITA model: DIST = control variables+NITA. DPDTADJ model: DIST = control variables + DPDTADJ. NQAFLOW model: DIST = control variables + NQAFLOW. CFFO model: DIST-control variables + CFFO. Variables are defined in Table 3.

changes in monetary assets and monetary liabilities are useful in the short-run, contrary to Thomas's contentions, we found that the change in inventory, a non-monetary account, is an important predictor of financial distress one year before the event.

Findings also suggest that depreciation and amortisation and deferred tax allocations may actually dilute the predictive usefulness of traditional accrual ratios, resulting in less meaningful accounting information to creditors. Eliminating these accounting allocations from a net-quick-assets flow model's scaling measure resulted in a stronger prediction model every year. Also, in no year did a net income model (NITA) including traditional scaling measures outpredict a model including an income measure adjusted for depreciation and amortisation and deferred tax allocations (DPDTADJ).

These results suggest that income calculations including depreciation and amortisation and deferred tax allocations, such as net income, may not be as useful in predicting financial distress as operating flow measures that exclude these two major financial accounting allocations. Users interested in predicting financial distress should be wary of income measures that include depreciation and amortisation and deferred tax allocations.

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Venture Capitalists, Unquoted Equity Investment Appraisal and the Role of Accounting Information

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Abstract—This paper aims to add to the understanding of venture capitalists' investment decision-making behaviour by providing evidence relating to the general policies they adopt in their approaches to due diligence, valuation methods, benchmark rates of return and adjustments for risk. The evidence shows that in order to address potential adverse selection problems, venture capitalists use a wide range of accounting and non-accounting information and techniques relating to the specific factors concerning a particular investment. Unpublished accounting information and subjective information are important. Significant differences emerge in the approaches to valuation and use of accounting information for valuation purposes between types of venture capitalist, according both to their stage of investment focus and whether they were captive or independent.

Introduction

In two seminal papers, extending the work of Lee and Tweedie (1981), Arnold and Moizer (1984) and Moizer and Arnold (1984) provide important evidence on the behaviour of investment analysts in appraising investments in ordinary shares. Subsequent research has updated these findings for the UK and extended them to cover comparisons with Germany (Pike, Meerjanssen and Chadwick, 1993) and the use of annual reports by investment analysts (Day, 1986). The focus of attention has very much been on analysts' behaviour with respect to recommendations regarding buy/hold/sell decisions. The emphasis in these studies has also been on equity investments in quoted companies. A parallel set of issues relates to the appraisal of investments in unquoted shares and in particular the behaviour of venture capitalists in this regard.

Several studies examine the relative importance of a wide range of factors taken into account by venture capitalists in the screening process for new venture investment (for example, Bruno and Tyebjee, 1985; MacMillan et al., 1987; Fried and Hisrich, 1994). MacMillan et al. (1987) show that the most important criteria venture capitalists use in screening investment proposals were entrepreneurial personality and experience, with lesser dependence being placed on market, product and strategy. For the UK, smaller sample studies provide a broad overview of the appraisal process among larger venture capitalists (Dixon, 1991) and address the use of accounting information in the venture capital monitoring process (Sweeting, 1991).

None of the above studies addresses important issues concerning venture capitalists' use of information in adopting the returns they seek and in the valuation methods used. Yet such issues are important. Venture capital firms' investment decisions are highly influenced by the extent to which they can identify appropriate investment candidates. In addition, they are also influenced by the extent to which they can invest on the basis of initial valuations, which enables target rates of return to be achieved and satisfactory returns made for the providers of funds to the venture capitalist. An important aspect of investment decision-making behaviour is the extent to which valuations and target rates of return hurdles are adjusted in the light of general and specific conditions. Pre-investment appraisal issues raise crucial problems in the potential effectiveness of institutional investors' subsequent post-transaction monitoring (Stiglitz and Weiss, 1981). To the extent that these problems lead investors to misjudge the situation, an agreed deal and accompanying financial structure may turn out to be inappropriate and possibly unviable. As a result, the control mechanism introduced by the commitment to meet the cost of servicing external finance may lead to sub-optimal decisions.[1] Alternatively, a deal that would have been viable may be rejected.

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Given the importance of these issues, this paper aims to add to the understanding of venture capitalists' investment decision-making behaviour. By taking account of these issues, venture capitalists may further reduce potential adverse selection problems at stages in the appraisal process beyond the more general analysis of information, as in the studies referred to above. The paper provides evidence relating to the general policies adopted by venture capitalists in respect of approaches to due diligence, valuation methods, benchmark rates of return and adjustments for risk. It investigates the types of accounting and non-accounting information used in effecting policies relating to valuation and adjusting expected rates of return for risk. The existence of a potential adverse selection problem leads to the expectation that venture capitalists will use a wide range of information and techniques relating to the specific factors concerning a particular investment. Unpublished accounting information and subjective information may be expected to be important, but its use may vary between different types of venture capitalist, particularly depending on their emphases on stages of investment and on whether they are independent or captive. The paper seeks to identify the extent to which venture capitalists take account of specific factors, and the nature of the accounting and non-accounting information used in so doing.

The study relates only to the pre-investment, that is the 'buy' or invest decision, aspect of venture capitalists' work and not to the 'hold/sell' decisions examined as part of the studies of investment analysts referred to above,[2] and proceeds as follows. The first section discusses the stages in the venture capitalist investment decision process, and highlights expected information needs and problems in obtaining such information. Section two outlines the data and methodology used in the study. In section three, the results are presented in relation to valuation methods and the information used in valuations, the setting and adjustment of target rate of return hurdles, and the reporting of the investments' subsequent performance to the venture capitalist's provider's funds. The final section discusses the results and draws some conclusions.

Framework and theoretical perspectives

In appraising potential investments, venture capitalists as principals are faced both with uncertainty and an adverse selection problem (Sahlman, 1990). As agents of funds providers, they are also faced with the risk that if they do not perform satisfactorily they will fail to attract further funding, which in turn may place pressure on the venture capitalist to make appropriate use of accounting and non-accounting information in reducing exposure to this problem.

Uncertainty arises in relation to problems in forecasting future performance. Adverse selection arises, as venture capitalists have to rely greatly on information about the enterprise's state of affairs supplied by the entrepreneur. Amit, Glosten and Muller (1993) point out that while the entrepreneur's familiarity with the industry, personal characteristics and track record can provide some insight for the venture capitalist, these criteria are at best partial predictors of future success and may not be conveyed to the venture capitalist in an unbiased manner. It may be expected that venture capitalists seek ways of both reducing the adverse selection problem and of taking risk and uncertainty into account. They may aim both to enhance the robustness of available information and use such information in ways that allow for these problems. Venture capitalists may exercise considerable efforts in due diligence to verify the robustness of accounting information, particularly profit and cash flow forecasts. In addition, they may make use of a variety of valuation techniques and adjustments to expected rates of return from potential investments in order to identify the scope of adverse selection problems. Schematically, the elements of this process may be identified as follows.

Our review of the existing academic and practitioner literature suggests that the stages in the venture capitalists' appraisal process can be portrayed as in Figure 1. Bruno and Tyebjee (1985), Bygrave and Timmons (1992) and Fried and Hisrich (1994) in particular have sought to identify the stages in the venture capitalists' appraisal process, and the stages presented in Figure 1 are derived from these authors' findings. Recent work by Fried and Hisrich (1994), which extends earlier studies, elaborates the screening stage to include consideration of whether a proposal meets firms' general investment criteria, whether a proposal is prima facie viable and the gathering of further information to enable a second stage screening to occur.

This implied iterative approach is supported by Steier and Greenwood (1995) who, using a single case study, emphasise its occurrence in the deal-structuring phase within the context of the need to conform to individual venture capitalists' bureau-

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[1] Investee remuneration schemes and the size and nature of investee stakeholding in venture-backed companies can to some extent address these issues, but the venture capitalist still requires a flow of accounting information in order to be able to monitor performance. However, this is likely to be subject to asymmetric information problems, and if adverse selection problems are present, then incentive systems may be set at inappropriate levels (for discussion see Mitchell et al., 1995, p. 188).

[2] For recent discussion of venture capitalists' post-investment demand for accounting information, see Mitchell et al. (1995).

Figure 1
Schematic Outline of Venture Capital Appraisal Stages, Policies and Information Requirements

Venture capital stage	*Venture capitalist's policy*	*Information*
1.Deal generation	General investment criteria	Broad indicators
2.Initial screening	General investment criteria	Business plan
3.Second/detailed screening	Due diligence policy	Business plan
	Valuation methods	Other accounting and non-accounting information
	Benchmark rates of return	
	Policy on assessing investees' rates of return, including effects of gearing levels	Specific and general information considered to affect rate of return and risk
	Policy on adjusting for risk	
4.Deal approval	Specific investment criteria	Investment executive/partner recommendation report based on prior stages

Source: Derived from Bruno and Tyebjee (1985), Bygrave and Timmons (1992), Fried and Hisrich (1994) and discussions with venture capitalists

cratic requirements. In terms of general investment criteria, Fried and Hisrich (1994) focus on venture capitalists' policies in respect of investment stage and industry preferences. As such, many proposals may not be formally valued, as they are deemed unacceptable at this early stage, either because they do not meet the criteria regarding the kind of proposals in which a particular venture capitalist invests or because, on the basis of initial information, the proposal is clearly not viable.

This paper's focus is on the stage in the appraisal process after a proposal has passed through initial screens, and has reached a more advanced stage where detailed valuation and assessment of potential returns takes place. This is stage 3 in Figure 1. Initial discussions with a small group of venture capitalists, intended to help frame the survey instrument, suggested that during this more detailed screening stage there is a need for firm-wide policies as well as detailed accounting and financial information. As seen in Figure 1, these policies involve the establishment of general firm-wide policies relating to due diligence methods, valuation methods, benchmark target returns, approaches to the assessment of returns from a potential investee and to the assessment of project riskiness. Figure 1 also indicates the broad nature of the information expected to be taken into account in this process. The results of the survey reported below show without exception the existence of at least one and an average of two formal organisational decision-making layers. As such, while venture capital executives may apply their individual skills and judgment to each particular case, our discussions suggest that they are likely to operate within the framework of an organisational policy. The interpretation and use of information in preparing a case to be presented to an investment committee will draw heavily on individual executives' skills. However, the need to be consistent about investment decisions, at least in part to guide the venture capitalist in making the returns indicated to their funds providers, emphasises the importance of organisation-wide criteria. As explained in the Methodology section, the focus of this paper is on these overall policies of the venture capital firm.

Following Fried and Hisrich (1994), information will be subject to extensive scrutiny and due diligence by the venture capitalist to ascertain its robustness before making a valuation. This scrutiny will include analysis of both financial and non-financial information provided by the entrepreneur and typically contained in the business plan, as well as information initiated by the venture capitalists and gathered from elsewhere. Forward-looking information, an essential element, is likely to be subject to sensitivity analysis by the venture capitalist according to the expected influence on future performance of other information. The first requirement, then, is for a policy on approaches to due diligence.

DeAngelo (1990) shows that for fair valuation assessments of management buy-out candidates, investment banks may use both a variety of information and techniques to produce a range of values within which an acceptable investment price can be negotiated. Indications from our initial discussions with venture capitalists are that a venture will in essence also be valued by applying one or more valuation techniques to the financial and accounting information relating to the potential investee. The second and third requirements concern the establishment of a policy on valuation techniques and the kind of information to be used in effecting such valuations. The existence of a potential adverse selection problem leads to the expectation that in making a valuation, venture capitalists will use a wide range of information and techniques relating to the specific factors concerning a particular investment. Unpublished accounting information and subjective information may be expected to be particularly important in providing a current, detailed assessment of the potential investee.

As may be seen from practitioner texts (for example, Sharp, 1993; Walker, 1990), valuations of potential investees will be used as a basis for determining the most appropriate financing structure and thence for calculating the expected internal rate of return (IRR), the performance measure most commonly used in practice by the venture capital industry (Lorenz, 1989). Where there is no clear-cut accept/reject decision, attempts may be made to reassess the variables in the decision-making process, renegotiation of the purchase price, and/or changes to the proposed gearing ratio in the financing structure.

In assessing rates of return there is an initial requirement for a general benchmark against which projects are to be judged. However, given the wide variety of possible types of investment candidates, venture capitalists may or may not apply a fixed benchmark to all of them. Hence, the second aspect of rates of return to be investigated is the extent to which venture capitalists have a varying target rate of return policy. To the extent that they do, interest then focuses on the relative importance of the factors taken into account in adjusting target rates of return. Besides the stage of investment (see below) these factors may be related to a range of general and/or specific factors including industry sector, expected length of investment horizon, and so on. In investigating the nature of these factors, the expectation is that general market factors will have some influence on expected returns in general. However, for a particular investment, venture capitalists are expected to place more emphasis on information relating to specific issues. Finance theory also suggests that expected returns need to be adjusted for the riskiness of a project, and again there is expected to be more emphasis on specific attributes.

Differences may arise between venture capitalists in respect of these issues and be associated with variations in the rates of return that are sought and the factors influencing those returns. In particular, two broad distinctions may have important implications for the demand for and use made of information. The first concerns those venture capitalists, important in the UK, who only target investments that are later stage (i.e., do not invest at all in seed or start-up projects), and those investing across all stages (Elango et al., 1995).[3] In 1994 later stage financings represented 94% of the total value of investments and 81% of the total number of financings made in that year by members of the British Venture Capital Association (BVCA, 1995). Given the established trading record of later stage investments, venture capitalists focusing on such projects may be expected to place greater emphasis on valuation methods that utilise historic information and to place greater emphasis on financial and accounting sources of information in preparing valuations. There is some debate in the US literature about the extent to which the use of non-accounting information varies between stages of investment, especially in respect of the greater emphasis placed by later stage investors on management characteristics and market acceptance of a product (Elango et al., 1995).

The second distinction concerns captive and independent venture capitalists. Captive venture capitalists—part of banks or insurance companies—do not have to raise capital (though increasingly they may) from third parties (Abbott and Hay, 1995). They are often viewed as investing primarily in later stage projects such as development capital and management buy-outs and buy-ins. Independents tend to be seen as the more traditional type of venture capitalist, are typically funded through limited-life closed-end funds, and may be more committed than captives to generating a return for investors through realising a capital gain within a more clearly specified period of time, while the latter tend to focus more on the income stream from their investments. In 1994, independent venture capitalists accounted for 54% of new funds invested (BVCA, 1995).

Data and methodology

It is important to note that, as indicated earlier, this paper is concerned with the general policies adopted by venture capitalists in their assessment of all types of investment. As such, an organisation-wide response was sought, with the questionnaires being sent to chief executives of the venture capital firms or senior colleagues with whom the Centre for Management Buyout Research has regular contact through its buyout and buy-in surveys. The covering letter to the questionnaire spe-

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[3] Some would go so far as to argue that late-stage investors, especially investing in smaller buy-outs, should not be considered venture capitalists (e.g., Bygrave and Timmons, 1992), though given that many such venture-backed transactions can involve considerable product and organisational innovation, this argument seems debatable (Wright, Robbie and Ennew, 1995). Moreover, from the point of view of the industry itself, all stages are encompassed in the term venture capitalists and reported in BVCA statistics.

Table 1
Due Diligence

Source of due diligence information	*Mean score+*	*Std. dev.*
Carry out own market evaluation	4.14	0.89
Place great reliance on personal references	3.94	0.86
Always have independent accountant's report	3.69	1.44
Never use same reporting accountant as management's accounting adviser	3.14	1.35
Always obtain independent market reports	3.09	1.17

Note: + where 5 = essential through to 1 = irrelevant

cifically asked repondents to report institutions' perceptions,[4] rather than individuals' approaches.

The survey was carried out in early 1994. A draft questionnaire designed to help the researchers understand the nature of the evaluation process was developed following initial discussions of up to an hour with a small group of venture capitalists and related practitioners. The questionnaire was then piloted with venture capitalists, advisers and academics. Following analysis of the replies, modifications were made to its content and structure.[5] The questionnaire was mailed to the 114 institutions listed as full members of the BVCA. Mailing of the questionnaires took place in March 1994. A follow-up reminder was sent to non-respondents in April 1994.

A total of 66 completed and usable replies were received, representing a response rate of 57.9%. A further 16 replies were received. Of these, eight had ceased investing in the UK, or their funds were now being managed by another venture capital institution. Reasons for non-completion among the remainder generally related to the size of transactions undertaken by the venture capital firm, or reflected a deliberate policy not to answer questionnaires.

Analysis of the respondents showed they covered a substantial proportion of the UK venture capital industry. Virtually all the principal and longest established venture capitalists in the UK had participated in the study. The respondents had on average been in existence for 13 years (median = 10.5 years) and employed on average 9.6 (median = 6) investment executives. Within the total sample, some 31 venture capitalists stated that they would invest only in later stage transactions, and 35 would consider projects at all stages. There were equal numbers of captive (include affiliate) and independent venture capitalists in the sample.

Results

The analysis of results is divided into four broad sections. The first examines due diligence, valuation methods and sources of information used in valuations. The second considers evidence relating to the target rates of return sought by venture capitalists. The third tests for differences between venture capitalists according to their stage of investment preferences and whether they are captives or independent, while the fourth relates to information used to value portfolios post investment.

Valuation

Due diligence reports. The importance of due diligence reports in preparing valuations was indicated earlier. The evidence in Table 1 reinforces the prime importance of venture capitalists' own reports, and the low standard deviation indicates generally high consensus on this source. Although all sources shown have at least moderate importance on average, personal references score higher than independent accountants' reports or other independent market reports. Both of those have higher standard deviations, indicating the existence of marked differences between venture capitalists.

Our discussions with venture captialists suggest that accountants' reports tend to be used more where verification of information relating to later stage investments such as buyouts is required. Moreover, because of the level of expertise required, it is generally the Big Six accounting firms that are employed where accountants' reports are used. Such reports may be more likely to be commissioned by the lead investor in cases where funding is to be syndicated between several venture capitalists, with the use of Big Six accountants playing a signalling role about the quality of the investigation to other syndicate members.

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[4] The letter said '. . .In order to obtain an overall view of the appraisal and valuation process...we are currently surveying these issues in depth. The enclosed questionnaire asks for institutions' perceptions on key elements of their equity investment appraisal process. . .'.

[5] A copy of the final questionnaire is available from the authors.

Table 2
Methods Used in Valuing Potential Investments

	Mean score+	*Std. dev.*
Historic cost book value	2.42	1.26
Replacement cost asset value	1.98	1.10
Liquidation value of assets (orderly sale)	2.05	1.14
Liquidation value of assets (forced sale)	1.97	1.06
Discounted future cash flows	3.23	1.37
Dividend yield basis	2.22	1.11
Capitalised maintainable earning (price/earning multiple)(historic basis)	4.27	0.86
Capitalised maintainable earning (price/earning multiple)(prospective basis)	4.31	0.87
Capitalised maintainable earning (EBIT multiple)	3.91	1.23
Recent PE ratio of the parent company's shares	1.97	1.00
Recent transaction prices for acquisitions in the sector	3.63	1.18
Responses to attempts to solicit bids for the potential investee	2.74	1.20
Industry's special 'rule of thumb' pricing ratios (e.g. turnover ratios)	2.97	1.13

Note: + where 5 = almost always used through to 1 = almost never used

Table 3
Selection of Final/Benchmark Valuation

	Mean score+	*Std. dev*
Place greatest weight on one particular method and use others as a check	4.15	1.13
Use the average valuation	2.61	1.25
Use the lowest valuation	2.33	1.11
Use the median valuation	2.29	1.08
Use the highest valuation	1.65	0.77

Note: + where 5 = almost always used through to 1 = almost never used

Valuation Methods. Various standard methods of valuing potential investments are used by venture capitalists, with more than one method frequently being employed.[6] Although methods may be grouped into three main types—asset value, price earnings multiple and discounted future cash flow basis—there is considerable variation around these basic methods of valuation, including identifying prices paid for transactions of a similar nature. Venture capitalists were asked to rate their use of each method on a scale ranging from 5 = 'almost always' to 1 'almost never' (Table 2).[7]

The most commonly used valuation methods employed were variations of price earnings ratio multiples. Overall, the technique with the best score was capitalised maintainable earnings (price earnings ratio) on a prospective basis, over half the respondents using this 'almost always'. A historic basis valuation was only marginally less frequently used, while capitalised maintainable earnings (EBIT multiple) was the third most common. In

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[6] The scale used was limited to a range from 'almost always' to 'almost never', and on the basis of a review of the literature and the pilot study, respondents were presented with the closed list shown in Table 2. While this might present some limitations to the results, it is unlikely to affect the rankings of the techniques, and our piloting suggested that the absence of the absolute extremities to the scale would be more acceptable to respondents. Respondents were not presented with the formal option to record a different method from those listed, but for purposes of the study all major known techniques were included.

[7] Of course, it needs to be borne in mind that not all the possibilities listed in Table 2 will be available in each case, which may introduce some element that the results reflect information availability rather than information usefulness. However, it is observable that some forms of readily accessible information such as historic cost asset values are in fact used relatively infrequently, while certain more difficult to obtain ones such as discounted cash flows are used relatively frequently.

Table 4
Sources of Information in Preparing a Valuation

	Mean score+	*Std. dev.*
Financial press	3.03	1.19
Trade journals	2.69	1.09
Interviews with entrepreneurs	3.65	1.14
Interviews with other company personnel	3.17	1.30
Government industry statistics	2.27	1.00
Statistical and information services	2.77	1.04
Other venture capitalists	2.82	1.05
Own due diligence report	4.47	0.75
Due diligence by accounting/consulting firms	3.75	1.17
Business plan: Balance sheet	4.00	1.05
Business plan: Profit and loss account	4.36	0.92
Business plan: Unqualified audit report	3.46	1.22
Business plan: Qualified audit report	3.70	1.25
Business plan: Unaudited management projections (1 year ahead)	4.03	0.91
Business plan: Unaudited management projections (more than 1 year ahead)	3.63	1.02
Business plan: Unaudited 'latest period' financial statements	4.00	0.99
Business plan: Overall coherence of business plan	4.06	1.06
Proposed exit timing and method	3.70	1.08
Sales and marketing information	3.80	0.88
Product information	3.47	0.99
Production capacity/technical information	3.42	0.95
Curriculum vitae of management	3.91	1.0

Note: + where 5 = vital influence through to 1 = no influence

contrast, reference to the recent PE ratio of the parent company's shares was reported to be used relatively rarely. This measure may, however, only be relevant in the case of buyout and buy-in proposals relating to divestments from quoted groups.

A further possibility is to obtain details of transaction prices for similar types of deal. Almost three-fifths of respondents usually or almost always used recent transaction prices in the same sector as a further yardstick. In over a third of cases, venture capitalists frequently attempted to solicit bids for potential investee companies as another means of establishing a valuation guide.[8] Discounted cash flows emerged as much more frequently used than asset value bases and was the fifth most common method. Although asset value methods may be common for bank debt analysis, over two-fifths of respondents almost never used replacement cost asset value or liquidation value asset methods, and a third did not use historic book value methods. Dividend yield bases were also less likely to be used.

There was generally greater consensus, as indicated by the standard deviations reported in Table 2, surrounding the use of the two methods receiving the highest average scores, while there was generally less consensus in respect of other methods, notably those based on discounted cash flow and asset valuations. It is notable, however, that the methods receiving the third and fourth highest average scores (EBIT multiples and recent transaction prices for acquisitions in the same sector) had relatively high standard deviations.

The evidence above implies that several valuation methods are regularly used by venture capitalists. Over four-fifths of respondents usually or almost always place greatest weight on one particular method but use others as a check. None appeared to make frequent use of the method that produced the highest valuation (Table 3).

These results provide some interesting contrasts with the studies by Arnold and Moizer (1984), and that by Pike et al. (1993). Venture capitalists, while also most frequently using forms of price earnings multiples, make more frequent use of discounted

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[8] Such an approach may involve contacting other venture capitalists (potential syndicate partners) on the basis of 'what if?', or eliciting information concerning the broad level of alternative bids for the company where the vendor is selling the company in an auction.

Table 5
Required Rate of Return on Equity

Rate of return	*Investment type*			
	Later stage	*MBO*	*MBI*	*Early stage*
Below 20% p.a.	5.9	1.9	0.0	2.4
21 to 25% p.a.	19.6	15.4	7.7	0.0
26 to 30% p.a.	25.5	19.2	15.4	4.8
31 to 35% p.a.	31.4	46.2	28.8	7.1
36 to 45% p.a.	15.7	13.5	40.4	19.0
46 to 55% p.a.	0.0	1.9	5.8	40.5
Above 55% p.a.	2.0	1.9	1.9	26.2
Total	100.0	100.0	100.0	100.0
Sample size	51	52	52	42

Table 6
Target Rates of Return

	Mean score+	*Std. dev.*
We require the investment to meet a standard required rate of return on equity (internal rate of return, IRR), regardless of the investee company's risk profile	2.27	1.13
We require the investment to meet a standard required rate of return on equity (IRR), according to the risk band of the investment	3.29	1.25
We require the investment to meet a specific required rate of return on equity (IRR), according to the characteristics of each investment	3.64	1.22
We require the funding structure to meet standard gearing ratios	2.06	0.98
We require the funding structure to meet standard gearing ratio according to the risk band of the investment	2.41	1.07
We require the funding structure to meet gearing ratios appropriate to each investment	3.94	0.98
We require a rate of return which yields a total cash return commensurate with amount invested	3.38	1.32

Note: + where 5 = essential through to 1 = irrelevent

cash flow approaches than asset-based methods. Their frequency of use reflects the use of this method in the calculation by venture capitalists of internal rates of return. Although there are theoretical problems with IRR, this technique is commonly used as a principal indicator of investment performance.

Sources of information in preparing a valuation. In preparing a valuation of the business, the venture capitalist may rely on a variety of information generated either by the entrepreneurs, or internally within the venture capital firm, or by obtaining external information, which either already exists or is obtainable on a specially commissioned basis. Our search of the literature and discussions with venture capitalists yielded 22 potential sources of information that could be of influence in preparing a valuation, each of which respondents were asked to rate out of 5, where 5 represented a 'vital influence' and 1 'no influence' (Table 4).

The critical source of information was rated to be the venture capitalist's own due diligence report, almost three-fifths of the sample seeing this as a vital influence. While due diligence was requested from accounting and consulting firms, relatively little emphasis was placed upon it (only just over a quarter of the sample scored it as having a vital influence). The overall coherence of the business plan was also important.

Accounting statements contained in the entrepreneur's business plan was the next most influential set of information, especially the profit and

Table 7
Targeted Return Variations

	Mean score+	*Std. dev.*
The expected length of investment in a particular proposal	3.52	1.00
The actual cash amount invested in a particular proposal (i.e. size of proposal)	2.81	1.08
Market conditions relating to a particular proposal	3.34	0.97
General economic conditions	3.16	0.88
Changes in returns for quoted equities	2.48	1.00
Changes in returns for long-term gilts	2.14	0.96
Changes in base rates	2.52	0.98
The actual cash amount you seek to receive from an investment	2.88	1.16
The industrial/product sector of the investment	3.11	1.01
The geographical region of the investment	2.06	1.11
The expected gearing ratio when the finance is structured	2.94	1.02
Whether you (and the institutional syndicate where appropriate) have a majority of the equity	2.40	0.87

Note: + where 5 = amost always through to 1 = never

loss account. However, considerable influence was assigned to unaudited latest period financial statements and management projections for one year ahead. Some influence was assigned to qualified audit reports and longer term management projections, but these were scored no higher than a number of non-financial pieces of information. The curricula vitae of management, sales and marketing information, interviews with management and proposed exit timing and method were especially influential.

Publicly available sources of information such as the financial press, trade journals and external statistical and information services were poorly rated, with government industry statistics having the lowest ratings of all. There was also a low level of influence of other venture capitalists.

In general, there was greater consensus concerning the most important factors, as indicated by the size of the standard deviations reported in Table 4. For the factors of less than average importance, there were slightly higher standard deviations, indicating that some venture capitalists did see these factors as being important, even though others did not.

These findings provide both similarities and marked contrasts with those of Arnold and Moizer (1984) and Pike et al. (1993). Pike et al. note the increasing emphasis placed on personal company contacts. However, venture capitalists require access to considerably more information of an unpublished and subjective kind than investment analysts appraising quoted companies can realistically hope to obtain, especially unaudited detailed management projections. Further evidence of the influence of this extra information is reflected in the wide range of factors covered in the business plan and due diligence procedures. These factors essentially provide the means by which the venture capitalist can test the robustness of the accounting and financial projections presented in the business plan, rather than simply taking such information that is presented at face value, and provide a means of addressing asymmetric information problems.

As with the scrutiny of extra information uncovered by investment analysts noted by Arnold and Moizer, the subjective judgment of individual venture capitalists is also likely to be important. Space precludes full elaboration of these results, but, in summary, the most important may be categorised as follows. The most notable factors relating to the entrepreneur's personality and characteristics were, in order of importance: evidence of ability to evaluate and react to risk well (mean 4.41); being capable of sustained intense effort (4.25); a clear desire to be wealthy (4) and being articulate in discussing the venture (2.82); attention to detail (3.5); and seeking independence (3). The two most important features concerning the entrepreneur's experience were that the entrepreneur had demonstrated leadership/managerial ability in the past (4.54), and was thoroughly familiar with the market targeted by the venture (4.54).

High rankings were also given to the entrepreneur with a track record relevant to the venture (4.24) and the ability to provide good references (4.2). In respect of product characteristics, the need for a product to have a strong market niche

Table 8
Assessment of the Riskiness of Investment

	Mean score+	*Std. dev.*
Nature of company's product market	4.29	0.80
Nature of the capital market	2.57	1.07
Contribution by management in terms of their managerial skills	4.76	0.53
Management's financial contribution	3.29	1.09
Expected time horizon to company's exit (stock market/trade sale)	3.52	0.93
Expected time horizon to redemption of preference shares	2.97	1.02
Expected participating dividend yield	2.49	1.04

Note: + where 5 = extremely important through to 1 = irrelevant

had the highest mean score (4), followed by the need for the product to have been developed to the point of a functioning prototype (3.71), the product enjoying market acceptance (3.82), perceived product quality and company reputation (3.88), and the experience and skills of the salesforce (3.62).

The most important market characteristic was that the target market enjoyed a significant growth rate (3.61). The two highest rated operational qualities were employee experience and skills (3.91) and organisational control systems (3.79). In respect of financial factors, the most important feature emerged as the presentation of a coherent and thorough business plan (4.2), closely followed by the state of financial control systems (4.14).

Targeted Rates of Return and Degree of Risk

According to our sample, the benchmark IRR used to evaluate expected after-tax returns was a mean of 29.2% (median 30%), a finding similar to that of Dixon (1991), though the time periods covered are different. Venture capitalists may use a standard benchmark IRR for investments, regardless of the investee company's profile, or may vary the required IRR according to the type of deal and its individual circumstances.

It may be expected that important differences in targeted rates of return will be reflected in the stage of investment, given the variation in risk factors between established and new firms (Lorenz, 1989). The survey shows that in moving from later stage to buyout to buy-in and finally early stage, the current required rates of return on equity, in terms of after-tax return, become progressively higher (Table 5). Although buyouts and buy-ins share the same median, the buy-in mean is considerably higher. Two-thirds of early stage investments look for rates of return of at least 46%.

Venture capitalists also adjust their targeted rates of return for smaller sized investments or where it is considered that there will be above average requirements for post-deal reorganisation, thus increasing risk. On average, the target return was 3.9% greater for small size investments (sample = 30), and 7.6% greater in cases where there was above-average requirement for post-deal reorganisation.

It is also possible that venture capital firms vary their required IRR according to whether they manage both closed-end funds as well as other sources of finance (e.g. own resources). Only 14.3% of the relevant respondents employed different target rates of return, depending on which funds were being managed.

Assessment of targeted rates of return. In terms of the required rate of return on equity, a flexible policy is generally adopted, involving the basing of targeted rates of return on the particular circumstances of each deal, rather than relying on deals meeting a standard benchmark rate (Table 6). More than two-thirds of respondents felt it was important or essential that the proposed investment met a specific rate of return on equity according to the individual characteristics of each investment, though the size of the standard deviation indicates that a substantial minority of venture capitalists do not share this view.

However, less than a quarter of venture capitalists attached the same degree of importance to the investment meeting a standard required rate of return regardless of the investee company's risk profile. Over half of the respondents felt it important or essential that the investment met a standard required rate of return according to the risk band of the investment, but this approach has a high standard deviation. A further feature was the importance attached to a deal being able to earn a rate of return that yielded a total cash return commensurate with the amount invested, but with the highest standard deviation. This appears to be important to only some venture capitalists.

Variation of targeted rates of return. The above analysis indicated that venture capitalists vary

Table 9
Significant Differences in Financial and Accounting Factors According to Investment Stage Preferences

Financial and accounting Factors	*Later stage only*	*All stage*
Valuation methods:		
Discounted cash flow	2.94	3.50+
Capitalised maintainable earnings (historic basis)	4.55	4.00**
Transactions prices for acquisitions in the sector	3.90	3.38+
Information used:		
Financial press	3.32	2.77*
Trade journals	3.00	2.43*
Business plan/balance sheet	4.26	3.77*
Business plan/profit & loss account	4.65	4.11*
Business plan/unqualified audit report	3.77	3.17*
Business plan/qualified audit report	4.19	3.25**
Business plan/unaudited 1yr projections	4.42	3.69**
Business plan/unaudited > 1yr projections	3.90	3.38*
Business plan/unaudited latest	4.26	3.77+
Due diligence:		
Always use independent accountants' report	4.26	3.19**
Terminate if inadequate current information	3.83	3.20*
Target IRR variations:		
Length of investment	3.27	3.74+
Cash amount invested	2.60	3.00+
Change in returns for quoted equity	2.76	2.24*
Change in base rates	2.73	2.32+
Risk assessment:		
Expected time to preference share redemption	3.35	2.63**

Note: significance levels for Mann-Whitney U test of differences between the two groups:
** 1%; * 5%; + 10%

their standard targeted rates of return to take account of deal-specific factors. The relative frequency with which each of a set of factors would cause the targeted return to vary was scored on the basis of 5 = 'almost always', through to 1 = 'never' (Table 7). The most frequently occurring factor, which would cause targeted returns to vary, emerged as the expected length of investment in a particular proposal followed by market conditions relating to the particular proposal, general economic conditions, the industrial or product sector of the investment and the expected gearing ratio when the finance was structured.

It was notable that changes in general financial variables, which would have an immediate influence on the quoted equity markets, had low scores. This finding is indeed surprising, given the need for the suppliers of funds to venture capitalists to ensure that the differential between the returns earned by venture capital firms and other types of financial instrument is maintained. Changes in returns for quoted equities, changes in returns for long-term gilts and changes in base rates were infrequently seen to respondents to be of influence.

Size of investment was only moderately important, although smaller size is associated with venture capitalists seeking higher returns, as noted above. In over two-fifths of cases, the geographical region of investment never caused targeted returns to vary. Given the need to control the investment, it was surprising that rates of return did not vary according to whether the venture capital firm (or syndicate) had a majority of the equity. There was generally greater consensus about the most and least important factors, as indicated by the size of the standard deviations. However, the high standard deviations around the relatively low average scores for geographical region, and in respect of the amounts of cash investments and returns sought, suggests that for some venture capitalists these are important influences on target returns.

Table 10
Non-financial Factor Differences Between Investment Stages (Mean Scores)

	Later stage only	*All stage*
Meets minimum funding levels	4.23	2.86**
Company is profitable	3.45	2.50**
Positive cash flow history	3.48	2.40**
Three to five-year exit horizon	3.90	3.31*
Entrepreneur handles risk well	4.62	4.23*
Entrepreneur seeks security	1.58	1.97+
Entrepreneur demonstrated leadership	4.71	4.40+
Familiarity with entrepreneur	2.06	2.51+
Proprietary product	3.00	3.49+
Market acceptance of product	4.19	3.49**
High technical product	1.42	2.17**
Experienced sales force	3.81	3.46+
Product will stimulate market	2.55	3.26**
Little competitive threat	2.58	3.03+
Product will create new market	1.52	2.49**
Familiar region	2.81	3.51*
Overseas market potential	2.65	3.43**
Number	31	35

Note: significance levels for Mann-Whitney U test of differences between the two groups:
** 1%; * 5%; + 10%

Assessment of a project's riskiness. Venture capital firms assess the riskiness of an investment through various factors. Based on scores ranging from 5 'extremely important' to 1 'irrelevant', the dominant influence was management's contribution to the venture in terms of their managerial skills. Over two-fifths of respondents rated this as extremely important, and the very low standard deviation indicates considerable agreement between venture capitalists (Table 8). The second influence was the nature of the company's product market, with there also being a relatively low standard deviation. The actual financial contribution being made by the management was, however, considerably less important, although still the fourth most important factor overall and with the highest standard deviation. A further key factor in assessing the riskiness of the project was the expected time horizon to exit. Dividend and preference share redemption issues were relatively lowly rated on average and had higher standard deviations, as did the nature of the capital market. These findings indicate a greater degree of scrutiny of available information in assessing risk and adjusting target IRRs than suggested by Dixon (1991).

Different Types of Venture Capital Firm

In what follows, the focus of attention is on areas where there are significant differences between venture capitalists according to their investment stage preferences and whether they are captive or independent.

Investment stage preferences. Given the importance of later stage investments in the UK venture capital industry, as noted earlier, respondents were divided for purposes of the following analysis into those who would only consider such projects and those who would consider projects across the full stage range. Venture capitalists focusing solely on later stage investments placed significantly greater emphasis on valuation methods, which made use of past performance information, and sale prices of similar enterprises, than did those also prepared to fund early stage projects (Table 9). The latter placed greater emphasis than the former on DCF valuation methods.

As expected, venture capitalists focusing on later stage investments to the exclusion of early stage projects believe that financial information is of significantly greater influence in preparing a valuation than other venture capitalists, reflecting the greater reliability of such information in enter-

Table 11
Financial Factor Differences Between Types of Venture Capital Firm (Mean Scores)

Variable	*Mean score independent*	*Mean score captives etc.*
Stage preferences		
Must be an MBO	2.91	3.76**
Must be an MBI	2.69	3.45**
Valuation methods		
Replacement cost asset	1.69	2.12+
Capitalised maintainable earning		
-historic p/e	3.90	4.61**
-EBIT multiple	3.60	4.18*
Information used		
Statistical information service	2.48	3.06*
Other venture capitalists	3.06	2.58+
Overall coherence of business plan	4.31	3.81*
Proposed exit timing	3.94	3.45+
Due diligence		
Always independent accountant report	2.88	3.30**
Own market evaluation	4.39	3.88*
Target IRR assessment		
Funding structure to standard gearing	2.28	2.55+
Target IRR variations		
Effect of marketing conditions	3.48	3.19+
Change in long-term gilts	1.91	2.39*
Change in base rates	2.33	2.71+
Risk assessment		
Expected time to exit	3.73	3.30+
Expected participating dividend yield	2.21	2.76*

Note: significance levels for Mann-Whitney U test of differences between the two groups:
** 1%; * 5%; + 10%

prises with an established trading record. No significant differences were found in the influence placed on sales and marketing information, product and production information, and management's curriculum vitae.

Significant differences between venture capitalists with varying investment stage preferences were identified in the use of non-financial information (Table 10). Later stage venture capitalists place significantly greater importance on large-sized investments, profitability and cash flow, and relatively short exit horizons. Also, as expected, later stage investors placed greater emphasis on products with strong market acceptance, while venture capitalists also willing to consider early stage projects place significantly greater importance on a wider range of product and market-related characteristics. In contrast to some recent US findings (e.g. Elango et al., 1995), this study shows that later stage investors were significantly more likely to seek entrepreneurs experienced in leadership and able to handle risk.

Independents and captives. The earlier discussion suggested that there may be variations between different types of venture capitalist according to the nature of their fund and associated investment time horizons. In particular, there may be differences between independent and the group of 'non-independents', which includes captive, affiliate and public sector venture capital firms.

From the discussion in section two, general preferences for different types of investment may be expected to arise between different types of venture capitalist. This perception is strongly borne out by the survey, which shows that captives are significantly more likely than independents to prefer to invest in management buyouts and buy-ins (Table 11).

Table 12
Non-financial Factor Differences Between Type of Venture Capitalist (Mean Scores)

	Mean score independent	*Mean score captive*
Return >10 times investment within at least five years	3.18	2.43*
Target is profitable	2.63	3.27*
Positive cash flow	2.67	3.15+
Entrepreneurial compatible personality	3.03	2.39*
Entrepreneurial demonstrated leadership	4.36	4.73+
Entrepreneurial track record	4.09	4.39+
Functioning prototype development	3.39	4.03+
High tech product	2.09	1.55+
Production creates new market	2.30	1.76+
Market is mature	2.12	2.63**
Overseas market potential	3.36	2.76**
State of production facilities	3.39	3.88*
Organisational control systems	3.58	4.00*
Employee attitudes	3.82	3.45+

Note: significance levels for Mann-Whitney U test of differences between the two groups:
** 1%; * 5%; + 10%

Although both types of venture capitalist use a range of valuation methods, captives placed significantly more emphasis on historic P/E and EBIT multiples than independents, perhaps reflecting the greater interest by the former in enterprises with more established and stable performance records such as classic management buyouts and buy-ins (Jensen, 1986).

Independents place significantly greater emphasis than captives on more detailed specific sources of information, both in the potential investee's business plan and in respect of their own evaluations. Although both groups of venture capitalist score their own market evaluations higher on average than reports by independent accountants, captives place relatively more emphasis on such due diligence than independents. In particular, independent accountants' reports were found to play a significantly more important role in due diligence for captive venture capitalists. Over four-fifths of captives felt it was important or essential to have an independent accountant's report, compared to just over half of other venture capital firms. There may be little a priori reason why different types of venture capitalist seek different IRRs from the various categories of venture capital investment in general, and indeed the survey identified no significant differences between the two sub-samples in this respect.

Independent firms were more likely to vary targeted rates of return according to changes in market conditions relating to a proposal, and to pay significantly less attention to changes in interest rates than non-independents. Attitudes to both changes in base rates and changes in returns for long-term gilts saw most independents considering these as irrelevant or only slightly important (75.8% and 60.6%, respectively), with significantly more emphasis being placed on these by the group of captives and other venture capital firms (41.9% and 32.3%, respectively, seeing them as irrelevant or only slightly important).

Some venture capitalists place considerable emphasis on participating dividends, that is, significantly increased dividends linked to the level of profits, rather than exit in obtaining their required rate of return. In particular, captive and other venture capital firms that may have less pressure to exit than the independents, who are financed by closed-end funds, may be expected to pay closer attention to participating dividends. There were significant differences between the independent and other venture capital firms in the sample in this respect. Correspondingly, the different emphasis placed on exit timing by the two types of venture capitalist was weakly significant.

Independents place significantly more emphasis on the ability of a prospective investment to earn a high overall rate of return (Table 12). Examination of desire to exit in three to five years showed weak significance and that independents placed greater emphasis on this issue than captives and others. Independents were less likely than the group of captives and other venture capital firms to attach importance to backing profitable companies or those with a history of positive cash flow. Significantly greater importance is placed by captives on the entrepreneur's track and leadership records, the state of production facilities and organisational control systems, and the maturity of markets.

Discussion and conclusions

This paper has examined the role of accounting and non-accounting information in the valuation and assessment of potential investments and the setting of target rates of return. The study showed that in attempting to deal with potential adverse selection problems, venture capitalists place considerable emphasis on the specific attributes of a potential investee company both in relation to assessment of its value and the rate of return to be expected from it. While accounting information is an important element in arriving at a valuation and a target rate of return, it appears neither to be taken at face value nor to be the only kind of information used.

Significant differences emerged in the approaches to valuation and use of accounting information for valuation purposes between types of venture capitalist, according both to their stage of investment focus and whether they were captive or independent, reflecting the differing nature of the adverse selection problem in these cases. Significant differences in assessment and information usage were identified for a number of variables, such as expectations about timescales to investment realisation and the importance attached to carrying out own diligence. These differences may reflect independents' greater emphasis on earlier stage investments where there may be relatively little historic accounting information. There may also be considerable uncertainty about future prospects, which can only be assessed to the venture capitalists' satisfaction by their own expertise, which may be more specifically skilled and/or more attuned to the venture capitalists' perspectives on risk and uncertainty than it may be feasible to obtain through the employment of external advisers. As captives focus more attention on later stage investments, there is likely to be a more established market, organisation and set of historical financial information which renders due diligence more amenable to standard procedures and the use of historic P/E and EBIT multiple-based valuation techniques more reliable.

This study's findings show both similarities to and differences from those relating to investment analysts' assessments of quoted companies. First, in common with other findings, venture capitalists were found to use several techniques for estimating company valuations. In contrast with investment analysts, however, venture capitalists make greater use of discounted cash flow approaches and less use of asset-based methods, reflecting the use of IRRs as an important indicator of investment performance in this sector.

Second, in respect of the type of information used in assessments and valuations, venture capitalists are found to place most emphasis on very detailed scrutiny of all aspects of a business, typically including discussions with personnel and accessing considerably more information of an unpublished and subjective kind than investment analysts appraising quoted companies can realistically hope to obtain. Venture capitalists were found to place considerable emphasis on unaudited management projections. As with investment analysts, but to a considerably greater depth, venture capitalists use wider non-financial information to test the robustness of the accounting and financial projections presented in the business plan. This process provides a means of addressing asymmetric information problems.

The results and limitations of the study suggest areas for further research. In particular, while the approach used here has focused on the use of accounting and non-financial information in pre-investment analysis by venture capitalists, further research may usefully focus on attempts to discriminate between the relative importance of information used in assessing differing stages of investment by venture capitalists, and in assessing investments that were subsequently successful and unsuccessful. Further study may also be useful with respect to the rationales different types of venture capitalists (i.e., captives versus independents and all stages versus late stage only) allow to influence their preferences for different valuation methods, and sources of information. In the light of initial discussions with venture capitalists, the study was limited to an assessment of organisations' general policy approaches. Further research may be directed at assessing the approaches of individual executives within venture capitalists, particularly in respect of the processes by which accounting and non-accounting information is used in the assessment process, and in relation to the behaviour they adopt in interpreting general policy guidelines.

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Future Events—A Conceptual Study of their Significance for Recognition and Measurement A Review Article

W.T. Baxter*

Abstract—This short book reports discussions by a group representing the standard-setting bodies of most English-speaking lands. It studies the many ways in which future events influence accounts, and thus explores matters of fundamental principle. It dissects imaginary cases that illustrate the problems. These cases prompt tantalising questions, and should provide invaluable teaching material. Some of them show the difficulty of deciding whether various types of expected benefits constitute assets; after a year of losses, does the resulting tax carryforward merit a place in the balance sheet? Other cases call for comparison of benefits with costs: how should accounts value a lottery ticket or an exploratory oil well that has only a slight chance of success? Yet other cases illustrate the role of personal judgment; should accounts allow for likely changes in the law or business activity? The group's members were much preoccupied with the 'past event' that may signal an asset's birth; and they disagreed over many of the issues.

Introduction

An array of authorities, drawn from the International Accounting Standards Committee and standards boards of English-speaking countries, met in London to discuss the accounting treatment of future events. Their deliberations have been summarised in the book[1], which has three sections:

1. A discussion of the main accounting issues that hinge on future events.
2. A list of the definitions (of assets, liabilities, etc.) used by each of the participating bodies.
3. Imaginary cases that illustrate the issues.

Every time we draft accounts, we are to some extent influenced by the future. Accordingly this book has tried to set future events into 'a common conceptual foundation on which standard-setters can base their own accounting standards', and thereby enhance the prospect of international harmonisation.

A book on this subject should indeed not be written (or criticised) without a preliminary statement on relevant concepts. The book therefore starts with some general discussion—e.g. on whether past costs create assets, and on the interpretation of 'probable'. But this section is sketchy, and far from the promised 'common conceptual foundation'. To be useful, a review article must be based on a fuller framework—even if this means restating the familiar.

Framework and cases are perhaps best tackled in three steps: hopes versus facts; asset definition; and the role of judgment. The sequence of cases is best re-ordered so that some of them clarify each step.

Hopes versus facts

The most fundamental definition of wealth hinges on hopes of future benefits. For a whole firm, these are (in a cash economy) its likely net cash inflows; Hicks' a priori concepts come to mind. We rely on these hopes when we make many of our most important decisions.

But accounting rejects such wholesale guesswork about the future, and adopts a more down-to-earth approach: it confines itself to the separate items of fairly solid wealth that are 'already there'. Thus a farmer's most far-reaching decisions (e.g. on whether to sell the farm, and at what price) must reflect his estimate of future receipts; whereas his accounts show sheep already in the field. His estimates of composite flows rarely have close links with individual assets; and the assets are rarely linked with changes in the estimates.

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*The writer is emeritus professor of accounting at the London School of Economics. Suggestions by anonymous reviewers have greatly improved the article, which was submitted in September 1995, and accepted in December.

[1] *Future Events A Conceptual Study of their Significance for Recognition and Measurement*. L. Todd Johnson, principal author. FASB, 1994. v + 56 pp.

As the book's cases prove, it is not always easy to say whether wealth is 'already there'. At what point are we justified in turning expected cash flows into assets? When do a farmer's hopes turn into a sheep?

Several of the cases ask how dents in the expected flows should be treated:

- *Loss on continuing operations.* An airline will continue operating, but will for some time have losses. Should this year's accounts treat these as a liability?

The group that fathered the book held that a liability for the future loss should not be recognised. This view seems in accord with the rule that change in expected composite flows should not affect the balance sheet. And the accounts give a clearer picture of a firm's doings if each year's figures show what 'actually happens' in that year, i.e. reflect the undulations of ordinary trade.

- *Losses from operations being terminated.* An airline plans to discontinue a loss-making route next year. Is this expected loss a liability?

The group's members had diverging views. Some suggested that the managers' intent was sufficient reason for recognition. Others held that there is no liability until operations actually stop, and moreover the managers might change their minds; but this view could alter if later events made the decision irrevocable. The group's final view was that there is no liability unless the decision becomes irrevocable.

This seems right. Moreover, recognition would violate the rule that each year should bear its own trade losses.

- *Losses from operations being acquired.* An airline buys a subsidiary with a loss-making route. Should the accounts provide for the loss—by increasing liabilities and 'goodwill'—if the route will be kept, or alternatively if it will be closed? The group again ruled against recognition.

If accounting tends not to recognise hopes and fears, we might in passing ask why this year's accounts so readily make closing adjustments for likely losses from bad debts, claims for faulty work, etc. The answer presumably is that, where we have already recognised an asset or liability, sometimes we can make its value figure more accurate (e.g. a debt should be reduced if non-payment now seems likely); we are here refining the size of what is 'already there', and not making general predictions about future trade.

Where assets are recognised, accounting may still have trouble in deciding what size of unit to deal with:

- *Aggregation and combination.* When does a manufactured product cease to be raw materials, labour, etc., and become a separate asset? (And, we might ask, should the accounts of a hotel chain show stocks, furniture, cutlery, etc., or complete hotels?) The group was unable to reach a consensus on this question. (Perhaps the accounting unit should be the type of asset that the firm most commonly buys, sells, or transfers between departments, so giving rise to bookkeeping entries; but such clerical considerations hardly constitute principle. When we move from hopes to assets, we lack a logic that dictates the size of unit.)

Definition of assets

As would be expected, many of the cases concern more detailed problems of recognition and measurement. Our familiar definitions state that an asset is a source of benefits, and that the owner controls it. Definitions of liabilities are long-winded; in essence, a liability is an obligation to bear disbenefits; it is perhaps best thought of as a negative asset. A further rule is that, even if an item satisfies the above requirements, it should not be recognised unless it can be measured with reasonable certainty. An important corollary to the definitions, not stressed by the group, is that an asset or liability is separable, and so could be transferred to other people (e.g. by sale or gift); brands are obvious border-line examples.

Definitions by standard-setters also stress that an asset must be the result of a 'past event'. Presumably, this condition was first devised mainly as a safeguard against undue creativity. Possibly (perhaps certainly) an asset's birth is signalled by an event (e.g. a transaction or chemical spillage). But, if the benefits now appear assured, the prior event hardly seems to warrant much discussion. Yet the group laboured long and hard to detect events that would legitimise assets whose benefits are obvious; such sterile debate elevates a check against naughtiness into weighty principle.

Thus several of the cases involve tax. If a loss carryforward raises hopes of tax reduction when profit is again earned, an asset of sorts exists; but when is the event? Some of the group held that it takes place in the year of the loss; others that a second stage—the earning of the future profit—is also needed. On such reasoning, accountants must split into one-event or two-event factions. Degree of certainty is surely far more important; thus the asset should perhaps be valued with a probability factor.

Benefits and market price

In the eyes of its owner, an asset's value can be seen as future benefits, and alternatively as a market price. For many of his decisions (e.g. on buying and selling), benefits are the more important. But price is much more suitable for his accounts: it is less idiosyncratic and hazy, and gives helpful information.

Accordingly, although 'assetness' depends entirely on benefits, the balance sheet largely ignores them. It is blind to consumer's surplus; it does not show the maximum price that an owner, if pressed, would pay. It instead shows costs (historical or current).

Many of the book's cases explore value issues. They could have been better argued by contrasting benefits with price, and by invoking the disciplined reasoning of deprival value (a concept that seems not yet to have percolated very far afield). This reasoning relies on the marginal approach, i.e. poses the all-important 'what difference does it make?' question. The 'difference' that asset possession confers on an owner can be seen by comparing his states if (a) he remains in possession of the asset, and, alternatively, (b) is without it (e.g. stores are used up in production, or a car is destroyed in an accident). Suppose that my car will enable me to earn £x (the benefits). If I smash the car, I shall have to pay £y for another—and then shall still earn the £x; so the 'difference'—the advantage of ownership—is that it obviates my £y outlay. Accounting value (by the deprival test) is the £y replacement cost.

Awkward value problems can often be resolved with the aid of comparative budgets that list the owner's cash flows if (a) he stays in undisturbed possession of the asset, and (b) is deprived. Comparison of (a) with (b) spells out the shortfall due to deprival (usually the cost of replacement). If the deprived owner is fortunate enough to be insured, payment to him of the shortfall would be very suitable compensation.

One of the cases illustrates the matter well:

- *Lottery ticket.* A firm has paid $150 for a ticket. The number of tickets is known. The group considered the ticket's value if there is only one prize, and also if there are a number of smaller prizes. The group's members split between 'one event' and 'two event' (buying the ticket, and also winning at the draw). And they impressively demonstrated their statistical expertise by analysing definitions of probability, and by engaging in calculations of likely prize money. They thus found values of possible money benefits (but what about the fun?).

Their procedure seems completely at odds with principle. In accounts (as we have just seen) an asset such as a machine is not valued by looking at benefits but cost. There is no reason why the ticket—if the owners think it worth holding—should not be treated in the same way. Its value is $150.

'Market price' may mean the sum paid by the buyer ('entry price') or the sum received by the seller ('exit price'). Comparative budgets suggest that entry price is normally the right figure for accounts. So writers on this topic usually call value 'replacement cost'; but a deprived owner might not replace, or might 'replace' with a very different type of asset.

Some other relevant cases are:

- *Early retirement incentives.* A company has offered a large cash payment to staff members who agree to retire. So far, no agreements have been received, but many are expected. Does a liability exist?

The majority of the group said that there is a liability. Making the offer constitutes a 'past event'; the company no longer has discretion to avoid payment; and, as the offer has been made to 4,000 staff members, some future payments are almost certain.

Liabilities, like assets, should presumably be valued at a market price—the lower of the amount that the creditor would demand for cancelling the debt, or a third-party for assuming it. (The notion of 'replacement loan' is an aberration, for which alas I must take the blame.) In this case, the obligation is so ill-defined and uncertain that it could hardly be detached and treated as a market unit, i.e. it cannot be measured with certainty. So it does not seem to merit recognition.

- *Self-insurance.* A company that owns a shop proposes to become 'self-insured' against customer claims. It has in the last three years met only one claim, for $30,000 by a customer who slipped on a wet floor. So should the accounts each year recognise a $10,000 liability?

(The company would clearly be most unwise to give up insurance by an outside office. Three years is too short an experience; future claims may be more numerous and bigger. But let us not quibble.)

Some group members held that, as future payments are likely, they should be provided for. Other members disagreed; they argued that no liability exists as there is no 'past event' until a claim results in a legal obligation; and earlier recognition would mean that future accounts would not show what 'actually happened' in each year. The group settled in the end for this view.

It seems right. Here the company could indeed get a third party—an insurance office—to take over its risks, in return for a yearly premium (presumably of more than $10,000); the item is detachable and marketable. But there is no existing asset or liability that calls for revaluation. Moreover, if the company decides on self-insurance, the size of future payments must be quite uncertain. (And the accounting could be horrific. Suppose $30,000 is paid in the year of the scheme's adoption. Would a $20,000 'asset' then be carried forward to the next year?)

One of the cases turned on high risk:

- *Exploratory well.* A company is drilling a well in the hope of finding oil. If oil is found, the benefits will be large; however, there is only a one in ten chance of success. Does an asset exist?

Here the group was again split between one-event and two-event (obtaining the lease, and striking oil as well). And some members of the one-event sect were disinclined to recognise the asset because of the small probability of benefits. Apparently the majority agreed in the end that an asset exists so long as there is a 'reasonable expectation of future economic benefits'.

The well's circumstances are more dramatic than those of an ordinary asset, but the reasoning should surely be the same. Suppose the owners are deprived (e.g. the well is destroyed by accident). If they then thought that the benefit prospects justified the sinking of another well nearby, the existing well is an asset: it obviates this potential outlay on replacing. High risk need not stop recognition.

Two cases dealt with depreciation:

- *Plant maintenance costs.* A company has bought a building with a 30-year life, and will charge straight-line depreciation. But there will be maintenance expenses: mechanical systems (e.g. air conditioning) have a 10-year life, and the roof has a 15-year life. Should these future expenses be recognised?

The group was surprisingly puzzled by the question. They argued about the 'event', and whether to show a liability or an impairment of assets —hardly a matter of fundamental principle.

Some members took the extreme view that there is no 'event' until replacements are imminent. Others argued for recognition, on grounds of conservatism ('anticipate no profits but provide for all losses'). Others agreed with this conclusion, but for a different reason: the building's acquisition can be regarded as the needed event. Yet others held that there is indeed no liability (the company does not owe anyone anything) till replacement contracts are signed; but the assets are impaired, so the building's value should be split between the three component assets, and each should be depreciated over its life.

The deprival concept disagrees only slightly with this last conclusion. An asset has been recognised, and so the accounts should correct for annual depreciation. Deprival budgets show that the asset's acquisition (and eventual renewal) bring the outlays of dates 0, 10, 15, 20, 0, 10, 15... So a deprived owner faces this whole series; whereas the undeprived owner faces (say in year 14) the less onerous series 15, 20, 0, 10, 15... The difference between the two series is the composite asset's value. (Discounting would reinforce this view.) Budgets of a year later will show a lower value; the fall is the composite depreciation. Whether or not the composite figures are split between three accounts is unimportant.

- *Future site restoration.* A company has just bought two mines, A and B. They have 25-year lives; A is already at year 15, and B is new. At the end of each mine's life, the company must restore the site, at a cost per mine of $10m. Of this, $4m is for restoration of 'overburden' removed at start of mining, and the rest is proportional to ore mined. How should the $10m be charged?

This case again gave rise to conflicting views. Some seven different approaches were suggested. At one extreme, members of the group held that the whole $10m should be charged at once. At the other, members held that no liability exists until the end of life, as there is not yet a contract to restore the site. In between were various other ideas for spreading the cost.

This case certainly is difficult. However, the final payments are inescapable; they are fairly predictable in size; and the obligation to make them could in theory be assumed by an outsider. So there seem strong grounds for regarding them as liabilities —the $4m at the date of overburden removal, the $6m in step with later depletion.

The start-up costs may well be deemed to include the assumption of the final $4m liability. So the initial book-keeping might reasonably show not only this liability but also an asset value that includes $4m.

Whatever the initial book-keeping, profits of later years should be reduced by a multiple charge, i.e. by provisions for both ordinary depreciation and the $4m and $6m. This treatment gets support from our treatment of a depreciating asset's final receipts, e.g. its scrap proceeds; its yearly depreciation charges are based on a net composite of price less the receipts. The logic of symmetry suggests that a mine's final payments (negative receipts) should be treated in the same way; a composite of initial and final payments should be split over the years (presumably in step with depletion).

If the firm is sufficiently sophisticated to use discounted present values, all the early figures will be much smaller than is suggested above.

This reasoning seems to cover the new mine B. We need more information about 15-year-old mine A. If a complete company is bought—lock, stock and barrel—its assets may include funds equal to the first 15 years' provisions for restoration; the new owner faces only the costs of the next 10 years. In the absence of such funds, he incurs an immediate liability for the $4m and (say) $3.6m of depletion; his later yearly charges must write these off as well as the remaining $2.4m, and so will be heavy.

The need for arbitrary judgments

The discussion of earlier paragraphs has assumed that, as is usual, an asset's benefits exceed entry cost. But they sometimes sink to less (e.g. with an obsolete machine): the asset is not worth replacing. Our traditional wisdom tells us that value now depends on benefits instead of cost; a deprived owner should value by finding the discounted present value of his lost benefits ('economic value').

This is perhaps too simple. A deprived owner could sometimes restore the meagre lost benefits by buying another kind of asset, or by paying for services (e.g. labour or the occasional hire of a machine); such a substitute brings a package of benefits that exceed the new type of cost, and so benefits are still not accounting value (which remains an entry price). However, sometimes there may seem to be no available substitute with a suitable package of benefits; then a discounted present value of benefits will indeed be needed. But use of a market discount rate seems still to equate value with a 'substitute's' entry price—the market cost of a similar set of cash flows (e.g. shares in a company with comparable risk). So value is still a form of 'replacement' cost; and consumer's surplus persists.

If value depended on discounted benefits, their size would be hard to find where (as is very usual) the asset works in a team with other assets. And value would often be a matter of highly subjective judgment, presumably by the owner or his agents the managers. There is no way to prove that such a judgment—made with due regard to facts—is right or wrong. Clever logic or wise accounting rules cannot help.

Several of the cases demonstrate the point:

- *Longevity bonuses.* A company pays a bonus to staff members on their retirement. The size of the bonus depends on length of service and final salary. Should this year's liability reflect (a) present salary, or (b) expected final salary?

Here the group's reasoning became somewhat cloudy, and was again dogged by 'event' troubles. An extreme sect argued that there is no event until the employee leaves, and so there is no liability till then. Advocates of (a) viewed services to date as the event, but linked the size of the liability to present salaries (because, for example, the company might change its policy regarding bonuses).

Advocates of (b) based the liability on the ultimate payment—so requiring a forecast of employees' leaving dates and salaries. This seems the right view (meeting the 'what difference does it make?' test); this year's service causes an ultimate payment whose size depends on future salaries; increases in these are likely, and therefore provision for them is a logical need. The calculation should use discounted present values, and be updated from time to time. If an outside pension fund could be persuaded to take over such liabilities, it would certainly demand a price that allows for salary increases.

True, the extent of the liability (particularly with a small population) must be a matter of crude estimate. Indeed, supporters of (a) could have argued with some force that this uncertainty rules out recognition of future salaries.

- *Idle drilling rig.* The company bought a rig while oil prices were still between $25 and $30 a barrel. When they fell to $19, the rig was taken out of service. There is no market for used rigs. The managers believe that oil prices will rise again. How should the rig be valued? (Much the same considerations apply also to another case, the *See Through Office Building.* Only 30% of its space has so far been let, but managers hope that demand will pick up.)

The group's deliberations centred on whether accountants are competent to predict the future, or should limit themselves to conditions now existing, i.e. should base the rig's value on today's gloomy outlook.

The blunt answer here is that accountants are not the people to predict anything.

Suppose first the owner feels that benefit prospects are still so good that, if deprived, he would replace the rig. His cheapest course would be to buy second-hand; he could probably get a rig for a small price plus outlays for dismantling and re-erection; current book-value is this cost. Next, suppose that his estimate of benefits drops to less than the new book-value. Deprival logic suggests that he must now ask what sum would make him feel just compensated for deprival of the hazy potential benefits. This sum (the entry cost of equivalent cash flows) becomes book-value. Clearly his judgment will be highly subjective, reflecting his degree of optimism and his liking for risk.

His accountants, auditors, etc. are of course entitled to disagree with him, and in particular to argue for using the figures of a wary arbitrator rather than his own perhaps too sanguine expectations. But (unless his accounts are to be used mainly by creditors, etc.) presumably it is he who in the end dictates what values are used.

- *Future tax rate changes.* The company has three divisions, A, B and C. Each has a loss carryfor-

> ward, and expects to set it off against taxable income in the coming year. A is in a land where a tax cut has just been enacted, but will almost certainly have to be delayed. B is in a land where a tax cut is likely. C is in a land where profits below $500,000 are taxed at 10%, and a higher band at 20%; profits now seem sure to be well above $500,000. How should the carryforwards be calculated?

The group argued over whether A and B should stick to the law now in force, or should rely on well-grounded estimates of probable future law. Their final view was that present rates should be used. This seems timid. If change in the law is highly probable, it would affect an owner's estimate of deprival value; and the accounts do not give an accurate picture unless the values reflect the likely future amounts. But 'highly probable' is a matter for personal judgment.

The group split over C. One part held that, as the future profits were unsure, the 10% rate should be used; another argued for the higher rate because increased profits were very likely. No consensus was reached. The group argued too over whether, if a higher rate were used, it should be 20% or an average such as 13.75%. If the carryforward would lead to a tax reduction at 20%, the marginalist approach must insist that the 20% rate yields the right 'difference'; the average rate, and talk of fifo, suggest naive allocation.

Conclusion

The book's cases are stimulating. They should be a gold mine for teachers.

Each accounting theorist places himself somewhere in a spectrum between two hostile views. At one extreme, he looks only to ledger entries (and therefore backs historical cost, matching, etc.); at the other, he raises his eyes and looks at the facts of business life (using marginal ideas and budgets).

The authors of this book would probably claim to be at the enlightened end of the spectrum. But in fact their reasoning (perhaps constricted by their need to produce acceptable standards) wobbles precariously between the extremes.

The book can be looked on as a shop-window for official accounting theory. The wares on view are hardly alluring.

Book Reviews

Financial Management for International Business. *I. Demirag and S. Goddard.* McGraw Hill, 1994. 390 pp. £19.95.

One of the fastest growth areas in business publishing in the last few years must be that of international financial management. This book is one of a number of texts aimed at final year undergraduate and post graduate students specialising in either finance or international business. Therefore, when assessing the suitability of this text, it is not sufficient to look at it in isolation. Instead, the book must be compared with the alternative books in this area.

The authors argue that although there are 'several admirable US texts on the subject, much of their content relates specifically to the institutional, accounting and tax frameworks of the USA'. This is perhaps an overstatement, as most texts (including this one) contain relatively little on the specific characteristics of any country(s). However, UK students are likely to become very frustrated at the almost exclusive use of US companies and US dollar examples and problems in what are otherwise excellent American texts such as Shapiro (1994).

One of the clearest strengths of this text is that it provides copious examples, illustrations and problems that are almost exclusively either UK or Europe based. However, while this makes the text far more accessible to UK students, it is not the only, or even the best, alternative. A more appropriate approach might be to adopt a truly international perspective. This is obviously more difficult to do, as country-specific factors cannot be ignored, but, instead, important differences across countries need to be explicitly explored. This approach has been attempted by Sercu and Uppal (1995). However, while they include the use of examples from a wide range of countries and currencies, the attempt is not entirely successful, as institutional factors are generally ignored while the structure of the book and the style of writing still give it a strong North American flavour.

The book is divided into three main parts. Part one looks at international financial institutions, part two covers international risk management, while the final part covers international asset management. The first two parts cover most of the material traditionally found in texts on international financial management, while part three includes a range of topics not found in most competing texts. These include chapters on: political risk; transfer pricing; performance evaluation and control; pressures for short-term performance maximisation; and international taxation.

The three chapters of part one are very largely scene-setting, covering the international monetary system, international financial markets (defined here as Euro-markets) and international banking. All are covered in a mere 45 pages and are therefore very brief. While most of the necessary material is included, there are two problems with this part of the book. The first is the all too familiar one of deciding where to begin. Thus, for example, Chapter 1 describes the Bretton Woods agreement and EMS before it is explained what foreign exchange rates are and why they change over time (issues covered in Chapters 4 and 5). Second, despite the brevity of these chapters, there is a tendency here (and also occasionally later in the book) for the material to lack a clear focus. For example, it is difficult to follow the logic of the decision to devote six pages to describing the third world debt crises while only one brief paragraph is devoted to international equity issues.

Part two consists of seven chapters covering: foreign exchange markets; exchange rate forecasting; measurement and management of foreign currency exposure; swaps; futures and options; and the management and financing of international trade. These chapters have a similar format. Exhaustive examples are provided, increasing in complexity from very simple to quite complex. Most chapters also include additional readings and questions.

The examples and questions are a very great strength of this text. They add considerably to the understanding of the material and sometimes they are essential as the text is somewhat difficult to follow in a few places. Most of the material covered in these chapters is very similar to that found in competing texts.

As with part one, the material tends to be presented in a very concise manner and is generally highly descriptive. Most is presented in a very procedural manner and it is noticeable that there is no discussion of areas such as the organisation of foreign exchange risk management functions in companies or corporate-banking relationships. It is also disappointing to find that the material is not made more interesting by using illustrations of real examples of corporate behaviour. This, for example, is a clear strength of a competing UK text by Holland (1993).

Part three is the most interesting and well-written section. In particular, it is the only section that consistently attempts to provide a description of empirical studies or to provide a critique of the subject matter. This part really covers two areas. First, it covers long-term decision-making in multinationals. Included here are Chapter 11, providing a brief review of the reasons for foreign direct investment and a discussion of international portfolio diversification. Chapter 12 looks at international capital budgeting. While the questions of where the data comes from and how reliable it is are ignored, the chapter more than adequately covers such issues as suitable investment appraisal techniques and the cost of capital. This is followed by a discussion of political risk, both measurement and management.

Chapter 14 looks at transfer pricing, in particular at how the choice of a suitable technique is affected by a variety of additional institutional and political factors in an international setting. Chapter 15 explores the evaluation and control of global operations, with much of the chapter reviewing prior empirical studies. While this is well written, it is very largely based on an earlier article by one of the authors, and much of the material covered is now very dated.

The penultimate chapter looks at the pressures for short-term performance maximisation by UK companies. This is perhaps the most interesting chapter of the entire book, although the conclusions drawn are overly simplistic. In particular, having looked at Germany, France, Italy and, inevitably Japan, the authors conclude that what is required in the UK is better education, improved corporate governance, tax breaks for long-term investments and changes in the performance evaluation systems companies use. Finally, international taxation is very briefly explored in the last chapter.

To conclude, whether or not this text offers a real alternative depends crucially on what is required from a text about international financial management. The first two parts are not as well written nor as easy to follow as the other UK texts in this area (see Buckley, 1992; Holland 1993). However, this is the only text to cover transfer pricing, performance evaluation and control issues, and pressures towards short-termism. If what is required is either a text that includes these issues or a text that provides very many numerical examples and questions from a UK perspective, then this is the only available text.

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University of Exeter Clare B. Roberts

New Tools for Management Accounting. *Malcolm Smith.* FT Pitman Publishing, 1995. x + 245 pp. £29.99.

This book examines many of the so-called new management accounting tools talked about recently in academia and practice, with the aim of seeking to 'identify the underlying themes and integrate common messages' (p.ix). The book is organised into 10 chapters and a useful bibliography. It starts with a brief introductory chapter describing the nature of information in broad terms to include quantitative (both financial and non-financial) and qualitative information, and the chapter concludes by drawing attention to potential goal conflict caused by misperceptions and reliance on short-term financial measures.

Chapter 2 describes the main developments in management accounting that emerged after the 1920s, thereby challenging Kaplan's thesis that little has changed in management accounting texts since the 1920s, and then reviews the findings of some UK based management accounting surveys conducted in the late 1980s.

A very long chapter (80 pages) is devoted to strategic management accounting. It begins with a brief discussion of objectives and proceeds to examine issues such as situation audit (focusing on SWOT analysis based on financial indicators; competition SWOT analysis; market SWOT analysis; environment SWOT analysis), benchmarking, strategy alternatives emphasising creative thinking and creative reporting, and evaluation. The chapter ends by considering some of the accounting system implications, including product profitability and customer profitability.

Chapter 4 is concerned with the measuring of processes. The chapter examines different patterns of cost behaviour, activity-based costing, activity-based management with its emphasis on costs, quality, time and innovation. Chapter 5 deals with total quality management, and it discusses several steps to operationalise that philosophy. It also examines the quality improvement process and offers some advice on how total quality paralysis can be overcome, and how control, perceived as the missing link of TQM, can be incorporated in that philosophy.

Chapter 6 covers value-added management and examines in more detail innovations such as just-in-time, total employee involvement, and quality control. Chapter 7 describes numerous non-financial indicators, which are grouped under input, work performance, product, market, employees and customers. Chapter 8 focuses on financial modelling, in particular corporate failure prediction models and risk measurement.

Chapter 9 identifies five key dimensions of management accounting: goals, customers, employees, processes and information. Finally, Chapter 10 explores some future directions in management accounting, covering in particular, control of overheads, market orientation reflecting the need to focus on 'management' rather than 'cost' aspects of functions, database integration, and reward structure.

Overall, this is a well organised, clearly written book which is accessible to a wide audience, in particular students and practitioners. Most of the chapters include one or more detailed case analyses through which the author clarifies and demonstrates how a particular technique (for example, risk analysis, or activity-based costing) can be operationalised. It is also refreshing for a book that is mainly aimed at practitioner level to engage with some of the academic literature, even though at a purely technical level, and to take issue with some of the arguments that may be very popular with practitioners, such as those of Kaplan. There is, however, too much emphasis on the technical side of things to the exclusion of crucial organisational and behavioural issues. This particular omission is likely to disappoint many academics.

UMIST Mahmoud Ezzamel

Readings in Mergers and Acquisitions. *Patrick Caughan* (ed.), *Basil Blackwell*, 1994. xiii + 364 pp. £45 h/b; £19.99 p/b.

This book provides a selection of 19 readings taken from the mainstream US literature on mergers, acquisitions and related topics, at a reasonable price. The papers fall into three natural sections, which I discuss below, without intervening discussion or attempts at synthesis.

As such, the book is a useful reference for graduate students and staff wishing to familiarise themselves with the ruling orthodoxy in the US literature, but I would feel more worried about placing it in the hands of undergraduates who lack the requisite context of, or commitment to, wider reading. On this point the book compares unfavourably with the excellent readers in accounting and finance produced out of Rochester. The text's countervailing strength is the accessibility of the chosen papers and their ability to bring the central issues to life.

Turning to the substance of the book, the papers fall into three categories: the theorisation and description of takeover activity; the finance of takeovers and the role of the high-yield ('junk') bond market; and, finally, broader issues in corporate governance and control.

Following an opening paper giving a brief history of takeovers in the US, the first group of papers give contrasting perspectives on the shareholder wealth effects of takeovers by Jensen and Roll. These papers give the basic theoretical background for interpreting subsequent empirical papers in the volume. Evidence to support the view that the market for corporate control is self-regulating is presented by Mitchell and Lehn's study of bidders who become targets. Corroborative evidence for Jensen's 'free-cash flow' hypothesis is provided by an examination between cash flows and bid-premia paid in LBOs by Opler. Sadly, no attention is given to those, such as Cosh et al. in the UK or Schleifer and Summers in the US, who remain critical of the mainstream orthodoxy, which means the text must carry a health warning for the credulous.

The middle section of the text collects together some of the classic references on the new issue high-yield bond market, and its efficiency and role in facilitating changes in corporate control. Each of the papers is fascinating: both the clarity of the exposition and the attention to issues of research method, with some added personal vitriol from Altman! (See p.186 for his retort to his critics.) Indeed, I could see Chapters 8–11 inclusive forming the basis of an excellent research methodology seminar.

The remainder of the book provides some empirical evidence regarding the forms of corporate governance in the US and their impact on corporate performance and ultimately survival. It is in this final section that the book begins to emerge from the confines of a tightly defined shareholder wealth-maximising market for corporate control framework dictated by the Chicago-Rochester research tradition. The three excellent papers by John Pound provide examples of a broader theoretical focus on the political economy of corporate governance and control rarely seen on either side of the Atlantic.

Overall, therefore, I recommend this text as a good starting point, but a bad end point, for those interested in research on mergers and acquisitions.

University of Manchester William Forbes

British Business History, 1720–1994. John F. Wilson. Manchester University Press, 1995. x + 276 pp. £40 h/b; £12.99 p/b.

As the author points out in his preface, while much work has been carried out during the last three and a half decades in the field of British business history, there has been a dearth of general works. While a number are known to be in preparation, this is the first to appear. It is essentially designed as a textbook for students on the steadily increasing number of undergraduate and postgraduate courses in British business history, but should also appeal to non-specialists wishing to obtain a broad understanding of a number of general issues in the overlapping fields of economic and business history. Wilson has managed to synthesise a large volume of recent research by economic and business historians into a highly readable form, for which he must be highly commended.

One problem for any author seeking to write a business history text is to define what is meant by business history. The author suggests that 'the main aim of business history is to study and explain the behaviour of the firm over long periods of time, and to place the conclusions in a broader framework composed of the markets and institutions in which that behaviour occurs'. At a more general level he suggests that, while it is a discipline that often uses a case-study approach, it can provide a dynamic insight into the evolution of capitalism, something of a tall order in 240 pages of main text!

The book uses a chronological approach, taking a general, overall view of developments, leaving the details of many aspects untouched. The author's stated aim is to provide a detailed analysis of such key factors as organisational dynamics, business culture, market opportunities, relationships between industry and finance, and shopfloor practices. Inevitably, however, not all of these is given equal treatment for each time period studied, and the emphasis is clearly stated to be on the evolution of British business culture and the socio-cultural pressures generating change. While some of these aspects are considered in detail, once again, to consider all the relevant issues would undoubtedly require more space than the author has at his disposal.

While the main explanation for change and development in British business throughout the period studied is to be found in the market-cum-technological environment, legal and ownership factors are also seen as being responsible for change. In this light it is perhaps somewhat surprising to find that there is little in the book on the legal requirements of company legislation. Someone interested in these issues would find it difficult to locate relevant material, since the index lacks any reference to general issues such as 'law', 'legal institutions', or 'the legal framework', neither are there entries for the various companies acts from the middle of the 19th century. While the implications of the 1948 Companies Act, particularly the changed accounting requirements, for the rise of takeovers in the post-second World War era are mentioned, no detail is presented, or any analysis undertaken. Indeed, throughout, with the exception of a short section on cost accountancy during the industrial revolution, accounting issues are virtually ignored in this book.

My main criticism, however, is that the book takes a macro perspective on the subject matter, largely ignoring the micro perspective. It too often reads like a conventional, chronological economic history text, such as when it discusses things like state-industry or bank-industry relationships. While this text undoubtedly gives far more attention to the organisation structure of firms than found in conventional economic history texts, there is a singular lack of case study material, something of which my own students would undoubtedly complain.

Despite these criticisms, however, this book is a must for anyone new to business history and/or wishing to find out more about the evolution of British business over the last three centuries, and the general environment within which British business operated. It may not be appropriate for someone wishing to learn about accounting history, or its relevance to business history, but the book is highly readable and provides an informed account of much of the recent work in British business history. Backed up by a sizeable bibliography, but with a somewhat limited guide to further reading, at £12.99 for the paperback edition, this is undoubtedly a book that all aspiring business historians, and anyone interested in the evolution of British business, can easily afford and should have on their shelves.

Cardiff Business School Trevor Boyns

Accounting and the Enterprise: A Social Analysis. *T. Colwyn Jones*. Routledge, 1995. xii + 300 pp. £40 h/b; £14.99 p/b.

This text represents a very ambitious undertaking, for which its author is to be commended. T. Colwyn Jones is a sociologist who tells us that he has spent 'much of the last 20 years teaching sociology to undergraduate students of accounting' (this in itself probably deserves a medal), 'grappling with accounting academic literature, and researching accounting practitioners in enterprises'. As a text on the sociology of accounting, it is concerned with 'enterprises and their relationship with accounting'.

After introducing the rise of the enterprise and of contemporary accounting, the author groups his chapters into four major sections: Capital (debates on ownership and control); management (debates on organisation); labour (debates on production); and accounting (social analysis and social theory).

Thus the text reviews social science theories of the enterprise in relation to the traditional (neo-Marxist?) classifications of capital, management and labour. Jones is concerned to examine and outline the influence of social theories on accounting theory, the way in which changes in organisations have influenced accounting practice, the way in which accounting practice has influenced organisations, and how a study of accounting theory and practice may lead us to revise the social science theories with which we began.

The text is aimed at 'business studies and social science undergraduates with an interest in accounting topics; trainee accountants on professional courses; postgraduate students of accounting and business; and accounting practitioners and others in business. . .'. Jones states that he has dismissed other readers such as lecturers and researchers in educational institutions from his mind. In one sense, his orientation is justifiable: reaching his target audience in the clearest and most accessible manner feasible. In another sense it is a too easily available attempt to avoid the critiques of his academic colleagues — forestalling suggestions for improvement by attempting to sideline the would-be commentators. In our earnest desire to assist the author in his worthy objectives of educating students, we critics shall come to his aid regardless!

Jones chooses to focus his attention on business enterprises and prefers to talk of enterprises rather than organisations, 'which is more common in business studies texts'. The omission of not-for-profit organisations is disappointing, given their major role in many societies, their economic power, and the growing volume of field and critically informed accounting research published on them. The term 'enterprise' is an unfortunate one in that it tends to be associated in many places with the notion of small enterprise, and is certainly not the dominant term used in accounting and management courses in countries such as the US, Australia, Canada and arguably the UK as well. In confessing that he has a particular theoretical viewpoint, Jones tells us that it would be dishonest to hide it, but then fails to disclose it, leaving us to the intriguing game of guessing what it is. My guess, for what it's worth (and I could easily be incorrect), is in complementary style, buried in my review above (and not so hard to find).

This book covers so much ground that it is extremely difficult to convey an adequate impression of its content or to structure a fair critique within the editor's bounds of 750 words. A few critical comments from this reviewer's own particular biases merit mention at this point. In covering the rise of modern accounting, Jones relies heavily on Pollard, whose claim that industrial revolution organisations paid little attention to costing has been superseded and refuted by the research of Fleischman, Parker and others. This leaves the reader with a somewhat inaccurate impression of history as far as research has to date penetrated and interpreted the past. In Chapter 2, the discussion of managers' goals tends to generalise from a UK study, which may be dangerous cross-culturally, but there is nonetheless an illuminating discussion of managerialism. International comparisons with Germany and Japan suggest grounds for a critique of globalisation from a situationalist perspective, but the issue of globalisation is only briefly mentioned.

In Chapter 3, on accounting for the enterprise, I searched for any reference to writings by Guthrie and Parker (vanity, vanity, all is vanity!) and to my disappointment found but one to myself — but, alas, my confidence is shaken. Since Parker (1986) does not appear in the bibliography, it could be my mentor, R.H. (Bob) Parker, the former book review editor of this very journal. On a more serious note, the coverage of social accounting without reference to the contributions of my colleagues Professors James Guthrie and Reg Mathews is suggestive of a UK/US bias. I choose to entirely disagree with the author's condemnation of the fate of social accounting, which a published study of top 50 UK, US and Australian companies during the time of Thatcher and Reagan (by Guthrie and myself), showed to be alive and kicking.

In Chapter 4, there seems to be a leaning towards Marxist preoccupations about the subject of organisations and control, with much less attention paid to the continuity of classical management perspectives, behavioural and systems theories. The transition to the discussion of social science theories is, as the author warns, no simple step. Chapter 8, on the social analysis of accounting (technical versus social, neutral or partisan, accountants as social actors) necessarily simplifies in order to communicate clearly to the uninitiated student. Possibly the simplification goes a little too far, and greater depth of coverage could be achieved within the same page budget.

Chapter 9 on social theory in accounting attempts a macro-classification of the majority of positivist research in accounting as functionalist. This may be an oversimplification. The critical theories are covered succinctly and clearly — an excellent introduction for students. As co-editor of a journal referred to on p. 255, however, I must register one complaint. The author cites it (and for that I am truly grateful) as *Accounting Auditing and Accountability*, omitting the word *Journal* from the end of its title (which has now included that last word since Volume 2 in 1989).

A final plus and a final minus must conclude. The international comparisons that appear, for example in the chapters on the organisation of the enterprise and production in the enterprise, are a welcome innovation, reflecting the rapidly growing focus on international operations in business and in management education. On another issue, the review questions at the end of chapters are simply compressed banks of short discussion-starter questions. Something rather more innovative for both students and teachers would be welcome.

Overall, despite the above apparently unwanted critique (but required of me by my namesake, the book review editor), this text is a very good read for lecturer and student alike. I enjoyed it. It has largely successfully taken on an extremely daunting challenge and delivered us a highly readable and engaging introduction to perspectives of accounting that are perpetually ignored by traditional textbooks. It will be an invaluable introductory primer for many students in the UK and overseas. Its appearance is a most welcome one indeed.

I am moved to complete this review with Colwyn Jones' own closing words to his acknowledgements: 'Finally a word of thanks and apology to my family. They have had to put up with my preoccupations, desperations and celebrations over this book for three years, and with my filling bedroom, dining room and kitchen with manuscripts, books, notes, photocopies, and all the other paraphernalia I seem to gather about me when I am working. It is nearly over now and I will tidy everything up soon, I promise.' Colwyn Jones has also tidied up quite a lot of things for student readers of this book.

Flinders University Lee D. Parker

Finance for Growing Enterprises. *Roger Buckland and Edward W. Davis* (eds.). Routledge, 1995. xii + 314pp. £45.

On the basis of 12 chapter contributions, the editors seek to provide a critical review of the sources of finance available to small and growing firms in the UK. The layout, roughly, is to follow the likely changes in the firm's sources of finance, and its relationships with those sources of finance, as the firm grows—from relying on overdraft facilities with a clearing bank, through to obtaining a stock market quotation.

The text begins by recognising that the UK clearing bank system is at the heart of small firm financing in the critical stages of early growth, providing around 90% of all small-firm lending. None the less, only the opening three contributing chapters are related specifically to the UK clearing bank system. This is because, while recognising both transaction and agency costs as difficulties for small firms, the opening three chapters combine to endorse the view that the extent of market failure for small and medium-sized enterprises (SME) is small. Thus, having laid to rest, as it were, the issue of the 'finance gap' in this domain, the remainder of the text is free to progress to the higher issues of venture capital and initial quotation (which constitute the remaining nine contributions).

The editors summarise the contributing authors' views on the traditional 'finance gap': 'Their (Bovaird, Hems and Tricker) crucial observation is that the barriers to emergent enterprises, which can be inferred from skewed patterns of financing, are as much a failure of entrepreneurs — of their demands for appropriate financing assets and for relevant consultancy services — as they are indicative of any failure on the part of the financial community to supply finance' (p. 270); and 'Dense layers of myth obscure these issues. Keasey and Watson, along with Binks and Ennew, establish firmly the mythical nature of banks' "discriminatory" practices, locating the experience of the smaller firm rather in entrepreneurs' reluctance to adopt appropriate financing structures that will be robust in the face of business instability' (p. 277).

The above clearly represents something of a forceful exoneration of the clearing bank system. But, personally, I did not find these chapters quite so convincing. For example, Keasey and Watson (while concluding that the empirical evidence is against the suggestion that small firms are in general being denied finance) concede that current arrangements commonly ensure that owner-managers continue to personally bear *all* the business risks associated with their actions without the banks' needing to engage in costly monitoring activities (p. 60). They remark that with the impact of the recession of the early nineties, the decline in commercial and private properties seriously undermined the main sources of the banks' securities so that they *were obliged* to take actions to reduce their exposure to increased levels of uncompensated risk (p. 76).

If banks are to be held as other than somewhat exalted pawn-brokers, the point must surely be the extent to which banks might be expected to adopt *a more income-gearing, prospects-based approach* to loan evaluation (as occurs in the US and Germany, for example; Binks and Ennew at least recognise such a possibility, p. 46). For example, if in order to raise credit facilities of, say, £50,000, I must expect to offer my family home, valued at, say, £100,000, as security so that I must be prepared to lose my home should I fail to satisfy my debt agreements with the bank, then who in reality is investing that £50,000 in my business: the bank or myself? If 'myself' is the answer, we might alternatively conclude following the above contributions, that very little finance is actually available to small UK firms!

If the counter reply is that we must recognise from the start of any UK empirical enquiry that our present clearing banks are simply not in the business of risk, then there is not very much left to say, other than to assume that the banks are essentially competent and not in collusion. But in this case these opening chapters can have the feel of a lot of embroidery on a small piece of cloth.

It worried me, in particular, that the editors state in their conclusion: 'There is, indeed, little reason to suppose that in a liberalised financial marketplace the capital market would not offer competitive products, rates and terms to firms that wished to avail themselves of support' (p. 277).

If such is the view at the outset, it cannot be surprising if it is also their conclusion. By one of life's ironies, as I read the editors' assessment of the 'mythical' foundation of any belief in banks' 'discriminatory' practices, I find myself catching the TV *Kilroy* topical debate programme (broadcast 9 November 1995). This particular programme has been given over to allowing the owner-managers of small firms to discuss their complaints about banks. The major clearing banks have refused to be represented, and, in their absence, there is a fair tirade of complaints about their discriminatory practices (in delivering the 'triple whammy' of taking businesses, homes and health). One member of the audience is asking how many of what the banks call 'rare' events does it need before they are no longer classed as 'rare'. Another participant is a farmer-owner, a certain David Cannon, who was in the news for expressing his dissatisfaction with his bank's handling of his business by spraying the front of the National Westminster Bank in Newcastle with four tons of cow manure.

It would appear that if the nature of banks' 'discriminatory' practices is merely the stuff of 'myth' as the editors conclude, it is not to be regarded as a myth in the sense of its basis being buried deep in the past. It is a myth that continues to be colourfully nourished!

The following chapters (5 and 6) cover the potential of venture capital as a source of equity finance for small firms. These chapters are interesting. None the less, they make clear that the external investor's requirements mean that only a relatively small proportion of firms will be able to, or want to, meet institutional venture-capital requirements. Neither is it likely that informal venture capital can be expected to transform UK financing of enterprise ('The contribution of venture capital to the funding of small firms in the UK is likely to remain limited', CBI, 1993). The remaining chapters (7 through 13) are devoted to a number of issues surrounding the institutional structures by which firms might aspire to a stock exchange listing. These chapters continue to be interesting.

As for the stage of achieving an initial public offering (IPO), Davis emphasises (Chapter 7), along with Buckland (Chapter 9) and Anolli (Chapter 12), that institutional rigidities in the IPO markets continue to be extremely costly to the emergent firm's owners, and render the change in status at firms' first quotation unnecessarily costly, uncertain and even potentially destabilising. The potential for increased segmentation of equities markets as a means to enhanced focus and specialisation of capital markets, and for lower barriers to entry for the emergent enterprise, emerge as important policy considerations (as considered by the editors, p. 278). The penultimate Chapter 13 by Buckland and Davis examines the need for small firms to review their financial systems at the point of entry to quoted status.

In summary, a weakness of the book for me was that it all too easily attempted to 'lay to rest' the issue of a finance gap for small firms in their formative years. The impression given is that the editors would rather move on to what they regard as more interesting topics, namely the provision of venture capital and issues relating to firms' achieving stock market listing. These two areas are in fact the greater substance of the book's contribution. I believe the book could have appeared more thorough and resolute if it had narrowed its empirical research to these two areas exclusively.

University of Leeds Mike Dempsey

Perspectives on Accounting and Finance in China. *J. Blake and S. Gao.* Routledge, 1995. xv + 382pp. £47.50.

This book of readings is a collection of the 19 papers (accepted from the many submissions to the conference organisers) presented at an international symposium on Chinese accounting and financial management held at the University of Central Lancashire in Preston on 21 March 1994.

The papers' authors come from Australia, the UK, the US and China. With the exception of, first, the introduction and the epilogue (or concluding overview), which were written exclusively by non-Chinese (respectively British and Dutch) scholars, and, second, articles no. 7, 12, 16 and 17, which were written by single or joint authors of Chinese ancestry, all the remaining articles were written jointly by Chinese and non-Chinese authors. Many of the Chinese and non-Chinese collaborations were the result of the relationship between a Chinese doctoral student and his/her British or Australian supervisor.

The introduction laments China's exclusion from the international accounting literature concerned with accounting regulations and practices. It suggests that adoption of western accounting practices in China has to be justified on the basis of their compatibility with Chinese cultural philosophy and ideology. As a result, it argues that China's peculiarities, and the nature of its accounting evolution, compel the inclusion of national 'ideology' as one of the predictors of national accounting regulation and practices.

The next article presents a graphic description of the attempts to raise the level of corporate reporting in China to a standard that is acceptable to western investors who are currently being attracted to invest there. These attempts include the establishment by foreign accounting firms of local practices in China, and the establishment of links with foreign accountancy bodies from Canada, Hong Kong, the UK and the US for the local training of Chinese accountants. All these links with international accounting firms and professional accountancy bodies would obviously erode the relevance and importance of the Chinese accounting ideology.

In Part II, the issue of Chinese economic reform is confronted. A backdrop to that reform is presented by Hwang and Tang in Chapter 7. The structural reforms currently taking place include: the provision of a range of incentives to attract foreign direct investment (Chapter 4); the development of joint ventures between foreign investors and entrepreneurs and Chinese government and businesses (Chapter 3); and the modernisation of Chinese stock and capital markets (Chapters 6 and 7). This part provides an array of interesting and important information about the Chinese business environment and its future.

Part III dwells on the new and first Chinese accounting standard devoted to the specification of a framework to guide accounting principles and practices — its creation (Chapter 8), its economic antecedents (Chapter 9), its similarities and differences from other national conceptual accounting frameworks (Chapter 10), and its national and international historical contexts (Chapter 11). There are many redundancies and contradictions in this part of the book. For example, one needs to compare Figure 8.2 with Figure 11.2 to understand the nature of some of the contradictions.

Part IV provides evidence of the effects of current Chinese economic reforms on computerisation, accounting research and financial reporting. This part is followed by a description of the reasons and effects of the reforms on the accountancy profession in China.

While the book began by emphasising the role of culture and ideology in accounting, Chapter 19 concludes the book by describing how and why cultural influence on accounting is vanishing. This chapter should have been located immediately after the first chapter. It neither drew nor learned from any of the chapters following Chapter 1.

The book is an essential addition to the international accounting literature. It is thin on finance (including only a chapter on investment climate and two chapters on the Chinese stock market). The book provides a detailed analysis of many features of Chinese accounting, though the reader should have been saved the ordeal of having to read the same points several times throughout the book.

Middlesex University R. S. Olusegun Wallace

Guide for Authors

General

Papers should be in English and consist of original unpublished work not concurrently being considered for publication elsewhere. They should be typed and double-spaced. *Four* copies should be submitted together with a submission fee of £18 for subscribers or £36 for non-subscribers. In order to ensure an anonymous review, authors should not identify themselves directly or indirectly. Experience has shown that papers which have already benefited from critical comment from colleagues at seminars or at conferences have a much better chance of acceptance. Where the research takes the form of field surveys or experiments, *four* copies of the instrument should be submitted. Where the paper shares data with another paper, *four* copies of the other paper must also be provided.

Presentation

A cover page should show the title of the paper, the author's name, title and affiliation, and any acknowledgements. The title of the paper, but not the author's name, should appear on the first page of the text. An Abstract of 150–250 words should be provided on a separate page immediately preceding the text. Authors are advised to observe the general style of presentation in papers already published, particularly in regard to the way text is sub-divided.

Tables and figures

Each table and figure should bear a number and a title and should be referred to in the text. Sources should be clearly stated. Sufficient details should be provided in the heading and body of each table and figure to reduce to a minimum the need for cross-referencing by readers to other parts of the manuscript. Tables and figures should appear at the end of the paper, with its most appropriate placing noted in the paper itself.

Footnotes

Footnotes should be used only in order to avoid interrupting the continuity of the text and should not be used to excess. They should be numbered consecutively throughout the manuscript with superscript arabic numerals. They should not be used in book reviews.

References

References should be listed at the end of the paper and referred to in the text as, for example, (Zeff, 1980, p. 24). Wherever appropriate, the reference should include a page or chapter number in the journal or book in question. Only works cited in the paper should be included in the list. Citations to institutional works should if possible employ acronyms or short titles. If an author's name is mentioned in the text it need not be repeated in the citation, e.g. 'Tippett and Whittington (1995, p. 209) state...'

In the list of references titles of journals should omit an initial 'The' but should not otherwise be abbreviated. The entries should be arranged in alphabetical order by surname of the first author. Multiple works by the same author should be listed in chronological order of publication. Some examples are:

Accounting Standards Steering Committee (1975), *The Corporate Report.*

Tippett, M. and Whittington, G. (1995), 'An Empirical Evaluation of an Induced Theory of Financial Ratios', *Accounting and Business Research*, Vol. 25, Summer, pp. 208–218.

Watts, R. L. and Zimmerman, J. L. (1986), *Positive Accounting Theory* (Englewood Cliffs, NJ: Prentice-Hall).

Style and spelling

Abbreviations of institutional names should be written as, for example, FASB and not F.A.S.B; whereas those of Latin terms should contain stops (thus i.e. not ie). Words such as 'realise' should be spelt with an 's' not a 'z'. Single quotations marks should be used, not double.

Mathematical notation

Mathematical notation should be used only where it adds rigour and precision, and should be properly explained in the text. Equations should be numbered in parentheses, flush with the right-hand margin.

Accounting and Business Research

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UK Accountants' Perceptions of Research Journal Quality

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Walter Taplin Prize

The British Accounting Association and *Accounting and Business Research* offer a prize of £100 for the best article published in each annual volume. The prize is named in honour of the journal's founding editor, the late Walter Taplin. The prize relating to Volume 24 (1993/94) is awarded to David Butler, Kevin Holland and Mark Tippett for their article, 'Economic and Accounting (Book) Rates of Return: Application of a Statistical Model'.

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Accounting and Business Research. Vol. 26, No. 3, pp. 187–199, 1996

A Study of the Environmental Disclosure Practices of Australian Corporations

Craig Deegan and Ben Gordon*

Abstract—This paper analyses the environmental disclosure practices of Australian corporate entities. The paper documents three separate but related investigations. First, in a review of a sample of annual reports for the 1991 financial year, it is apparent that environmental disclosure practices adopted by the sample are self-laudatory, with companies promoting positive aspects of their environmental performance, but failing to disclose negative aspects. Second, in a review of corporate disclosure practices in the period 1980 to 1991, environmental disclosure made by the sample significantly increases across time. This change is linked to an apparent increase in societal concern relating to environmental issues. Finally, using a questionnaire administered to environmental lobby groups, it appears that the extent of corporate environmental disclosure is positively associated with the environmental lobby groups' concern about the environmental performance of companies within particular industries.

Introduction

This paper explores the environmental reporting policies of Australian corporations. Environmental disclosures constitute part of what is generally termed social responsibility reporting. Social responsibility disclosures include, among other things, disclosures relating to the interaction between an organisation and its physical and social environment. Social responsibility reporting may include information about environment, energy, human resources and community involvement. In this paper we are concerned with disclosures related to the natural environment.

Within Australia there are no requirements, legislative or professional, for firms to disclose environmental initiatives undertaken, or the costs (however measured) the firm has imposed on the environment. In previous studies of environmental disclosures it has been shown that environmental reporting is typically qualitative in form and predominantly of a self-laudatory nature.[1] This paper seeks to contribute to the literature by reviewing and documenting the environmental disclosure policies of a relatively large sample of Australian companies in a more recent time period (relative to previous Australian studies).

This paper commences with a discussion of some prior empirical reviews of Australian corporate social responsibility disclosure practices. Following this discussion, we address three key issues in three separate but related sections of the paper. We initially explore whether the environmental reporting practices of Australian companies can be characterised as objective. Following this we investigate whether environmental disclosures have systematically changed across time and if so, we seek to provide an explanation for any systematic variation. Last, we explore whether the amount of environmental disclosure by Australian companies can be associated with the concerns held by a particular section of the community — the environmental lobby.

Australian empirical reviews

Guthrie and Parker (1990) undertook a comparative international analysis of corporate social disclosure practices in the US, UK, and Australia for 1983. They reviewed and documented disclosures related to the environment, energy, human resources, products, community involvement and other. They found that corporate social disclosures in Australia, as measured by pages within the annual report, were relatively low compared with the UK and US. Of the 50 Australian companies examined, 28 (56%) provided some form of social disclosure, in comparison to 85% of US companies, and 98% of UK companies respectively. The mean number of pages allotted to all social disclosures was greatest for the US (1.26 pages), and least for Australia (0.70 pages). In Australia, the UK and the US, the corporations appeared to similarly prioritise the types of social disclosures made. Human resource disclosures were greatest, followed by community involvement and then by environmentally related disclosures.[2]

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[1] For example, in Australia: Guthrie and Parker (1989 and 1990). In Europe: Fédération des Experts Comptables Européens (1994). In the UK: ICAEW (1992); Hines (1991).

In relation to environmental disclosures, Guthrie and Parker found, without exception, that no Australian company provided 'bad news' about its activities. The authors view this behaviour as potentially one in which firms adopt a disclosure strategy to counter criticisms of the corporation's activities. They consider that a sizeable proportion of social disclosures appear to be a reactive response to various social pressures exerted on the firm. They propose that corporate social disclosures can be explained as an attempt to respond to demands for social impact information from particular interest groups. As Guthrie and Parker state (p. 165), corporations may make voluntary social disclosures in order to:

> 'demonstrate a constructive response to social pressure and avoid further regulation of their disclosures. In this way they may seek to pacify sociological demands made on business while attempting to win or maintain support from particular targeted constituencies. Such a disclosure strategy may include emphasising the corporation's positive contributions to social welfare and highlighting its attempts to minimise its harmful effects on various elements of society'.

Guthrie and Parker (1989) also undertook a study of disclosure practices undertaken by BHP between the years of 1885 to 1985.[3] In their study they investigated whether there was an association between social disclosures (classified into environment, energy, human resources, products, community involvement and other as measured in quarter pages) and major corporate events (as evidenced by a number of available studies of BHP's history) that could be explained in terms of legitimacy theory. According to Guthrie and Parker (1989), legitimacy theory posits that corporate disclosures are made as reactions to environmental pressures (economic, social, political) and in order to legitimise the corporation's existence and actions. They sought to see if there was a concurrence between the timing of disclosures and related activities and events (p. 348).

Apart from environmental disclosures, their findings failed to support legitimacy theory.[4] In relation to the environment, they found that environmental disclosures were totally absent until around 1950, after which time they again were absent. The disclosures recurred in the early 1970s and 1980s, but remained at a relatively low level They found that environmental disclosures peaked in the 1970s, and they associated this peak with a time in which mining, steel and oil industries became targets for conservationists' criticism.

In an earlier study, Trotman (1979) examined social responsibility disclosures made by Australian companies for the period 1967–1977 and found them to increase across the period. In offering an explanation for this observation, Trotman posited that:

> '...social responsibility reporting may contribute to public image and this in turn may lead to greater public acceptance, more identification and avoidance of confrontation such as strikes and boycotts... by reporting social responsibility information companies are showing that they are acting responsibly and that there is no need for further legislation to force them to do so' (p. 27).

Trotman and Bradley (1981) investigated a number of factors that they perceived may have been related to corporate social responsibility disclosures. These factors, which were synthesised from some of the existing literature on social responsibility disclosures, were corporate size, systematic risk, social constraints and the management decision horizon.[5] They found that companies providing social responsibility information were, on average, larger in size, had higher systematic risk and placed stronger emphasis on the long term than companies that did not disclose this information. The authors did not attempt to relate their chosen independent variables to the different types of social responsibility disclosure, but, rather treated all social disclosures as a homogeneous item.

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[2] An issue worthy of further research would be whether contemporary social disclosures are similarly prioritised and, if not, whether a realignment in social responsibility disclosure priorities can be explained by changes in the communities' social values/expectations.

[3] BHP is one of Australia's largest corporations. It is primarily involved in the steel industry.

[4] However, and by their own admission, the data may have excluded a number of significant events or activities. Further the matching of peak disclosure levels with periods of significant social, economic or political events ignores potential lag in reporting behaviour. Also, as with any case study analysis there is a limitation with using only one subject. Nevertheless Guthrie and Parker did provide some early insights into som interesting research methodologies.

[5] The synthesisation process employed meant that numerou independent variables were tested in their study, and that thes variables had been generated from the adoption of various (and potentially conflicting) theoretical perspectives.

Objectivity of disclosure practices

Here, we have elected, relative to Guthrie and Parker (1990), to review a larger number of companies (197 compared to 50), in a more recent time period (1991 compared to 1983). Our aim is to provide evidence on whether environmental disclosure activity has increased since 1983, and whether firms are continuing to disclose in a self-laudatory manner. That is, whether companies are still providing 'good news' but no 'bad news'. Consistent with Guthrie and Parker, we adopt a legitimisation perspective to explain changes in corporate environmental disclosures.

To undertake the analysis of environmental disclosures, a sample of 197 firms' annual reports was obtained from the Australian Graduate School of Management (AGSM) annual report file for 1991.[6] The number to be reviewed was determined by using the following arbitrary selection criteria. Where an industry had five or fewer companies available on the AGSM report file, all of the companies' annual reports were reviewed. If there were more than five companies, 50% of the companies had their reports randomly selected for review (rounding down to the nearest whole number and ensuring that a minimum of five companies were randomly selected from each industry classification). Where firms were identified as operating in more than one industry, that company's total environmental disclosures were separately classified by industry.

The 1991 annual reports are examined for disclosures that could broadly be termed as information presenting the company as operating in harmony with the environment.[7] The amount of positive environmental disclosures in each case is determined by the use of content analysis, individual words being the basic unit of measurement. The measure is referred to as POS.[8]

Negative disclosures are obtained by reading the 1991 annual reports and treating disclosures that present the company as operating to the detriment of the natural environment as negative.[9] This measure is referred to as NEG.[10]

There are two major limitations associated with the use of content analysis to measure disclosure quantity. First, there is a necessary element of subjectivity involved in determining what constitutes a particular type of disclosure (Zegal and Ahmed, 1990). Given the potential problem caused by subjectivity, a number of the reports were analysed independently by both researchers. Word counts did not significantly differ. Second, it is assumed that the significance of a disclosure can be meaningfully represented by the quantity of disclosure (MacArthur, 1988). It is submitted that these limitations are unlikely to significantly affect the validity of this study's findings.

By counting words, which are the smallest possible units of analysis, maximum robustness to error in calculating quantity of disclosure is achieved (Zegal and Ahmed, 1990). Furthermore, as Zegal and Ahmed (1990) point out, the difficulties associated with content analysis are greater when a small sample of disclosures is examined. In this study 197 firms are examined, which suggests that unless any inherent error or bias in recording is systematic, the overall effect of any measurement error would be fairly negligible. What should be stressed, however, is that the method of measurement being employed here is not undertaken to yield figures that are exact or precise in any manner, but rather to provide an indication of systematic trends in environmental disclosure policies.[11]

The environmental disclosures found within the sample are largely qualitative in nature. The disclosures are typically found within the companies' chairman's report, managing director's report or equivalent. An overview of the types of disclosures construed as 'positive' and 'negative' is provided in the Appendix.

---

[6] A limitation of using the AGSM report file is that the file only contains approximately the top 500 firms by market captalisation. The results may need to be considered in the light of this restriction.

[7] Two examples of these types of disclosures from actual annual reports are: 'Implicit within the corporate strategy is the company's desire to operate in an environmentally responsible fashion and the need to respect and where possible exceed the environmental constraints imposed by legislation and industry practice' (Ampol Exploration 1991, p.3); and 'Technology development will ensure that the technology capabilities of Pasminco are at the forefront of the international zinc and lead industry and that the Group maintains an environmental strategy which meets the objectives of protecting human health and the quality of the environment, as well as prudent and rational use of natural resources' (Pasminco 1991, p.3).

[8] In addition to word counts, number of pages (as in Patten, 1992) and disclosures in pages as a percentage of the total number of pages in the annual report were also tested. The results, not presented here, were consistent with those reported in this paper.

[9] Examples of disclosures of this nature are: 'Claims emerged during 1991 that fertiliser (and pesticide) run-off from sugar growing areas of north Queensland may be damaging the Great Barrier Reef' (Incitec, 1991, p.20); and 'The site has some environmental problems because it has been used for industrial waste disposal for 50 years or more' (Adelaide Brighton, 1991, p.16).

[10] The classification of positive and negative disclosures adopted in this study is similar to Hogner (1982). Hogner reviewed 'good news' and 'bad news' disclosures made by US Steel between 1901 and 1980. 'Good news' was defined as information about corporate activities having a positive or beneficial impact on society. 'Bad news' refers to information about activities having a negative, deleterious impact on society, or failures in attempts to overcome social problems.

[11] Gray et al. (1995b) provides a very useful discussion of numerous methodological issues associated with the use of content analysis.

Table 1
A Comparison of the Amount of Positive and Negative Environmental Disclosures

Variables:	*POS*		*NEG*		
Test	*Mean*	*Std.dev.*	*Mean*	*Std.dev*	*Significance*
T-test *	4.420	1.312	0.671	1.300	$p<0.0001$
Wilcoxon	180.662	233.915	5.746	15.489	$p<0.0001$

No. of companies = 197

* *Note*: The t-test was performed after POS and NEG were logarithmically transformed. 1.0 was added to each NEG score prior to transformation.

Seventy-one firms are identified as voluntarily producing environmental information (positive or negative). These 71 firms are used to test the relative disclosures of 'positive' and 'negative' disclosures. A paired samples t-test and a Wilcoxon matched pairs signed ranks test are used to determine whether there is a significant difference in the amount of positive and negative environmental disclosures made by firms that disclose either type of information within their annual reports. The results are provided in Table 1.[12]

The results reported in Table 1 provide strong support for the contention that firms will disclose 'positive' news, but will suppress 'negative' news. As Table 1 shows, the mean amount of negative disclosures are very low — only 5.7 words per annual report. Although higher than the Guthrie and Parker (1990) survey, it still indicates that firms tend to be self-laudatory in their disclosure practices. The maximum amount of negative disclosure is 85 words, or approximately five lines. Only 14 companies out of the entire sample provide any negative environmental disclosures.

As a further indication of the overall difference between the extent of positive and negative disclosures, it is found that of the 71 firms that disclose environmental information, 70 firms provide significantly more positive than negative information. The maximum amount of environmental disclosures is 1,049 words, or approximately two pages. The top 10 environmental information producers come from the mining (uranium, coal, oil and gas, bauxite) industries (6), building materials industry (1), fertilisers (1), chemicals (1), and timber industry (1).

The observation that firms emphasise positive environmental information is interesting. As the readers of annual reports would have a general awareness of the potentially harmful activities that companies undertake, it is arguable that they would be cynical of firms that publish positive information in annual reports without any admission of the undertaking of environmentally harmful activities. Consistent with this, it could have been expected that firms would have an incentive to disclose negative information about the firm, given that it exists, in order to establish credibility with the public. As KPMG (1993, p. 16) states:

> 'Disclosing the bad news as well as good is very important if companies want to gain credibility for their reports. Otherwise, the reports can appear biased and akin to public relations tools. Even if there is considerable data, an otherwise 'good' report will invite suspicion on all its disclosures if companies are not "up front" about the problems they are facing, including fines and prosecutions.'[13]

Given the selective disclosure policies adopted in our sample, it would appear that corporate managements consider that the benefits from appearing to be objective are more than offset by potential negative effects that may result from the disclosure of negative information.

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[12] Some of the testing reported in Tables 1, 5 and 6 has been undertaken using data that has been transformed to eliminate statistical problems associated with the use of non-normal data. This is not uncommon in this type of research. However, what must be kept in mind is that in using word counts we are using relatively 'soft' data, and hence all conclusions drawn from the data, transformed or otherwise, must be considered in the light of any raw data limitations.

[13] This view is also reflected in a document released by the International Institute for Sustainable Development (1993). In its document, *Coming Clean: Corporate Environmental Reporting*, it states that 'some of the most effective report makers have been those that have been prepared to adopt a "warts-and-all" approach. Those that have taken this path have found that stakeholders are much more likely to believe the good news where there is also a frank, detailed discussion of the remaining problems' (p.46).

Table 2
Mean Amount of Positive and Negative Disclosures 1980 - 1991

	1980	*1985*	*1988*	*1991*
Mean amount of positive disclosure	12	14	20	105
Mean amount of negative disclosure	0	0	0	7

No. of companies in each year = 25

Changes in disclosure practices across time

Further testing is undertaken to see how, if at all, Australian environmental disclosures have changed across time. To test for these changes, a random sample of 25 firms from the entire 197 firm sample is selected. The selection procedure results in no more than three companies coming from any one industry, and 16 industries are represented in the sample. The annual reports for each of these 25 firms for the years 1980, 1985, 1988 and 1991 are examined, providing a total of 100 observations.[14]

The mean amounts of positive and negative disclosures (in words) for this sample of 25 companies across four years are provided in Table 2.

From the small sample, there does appear to be a significant increase in disclosure practice in the period from 1988 to 1991 ($t = 2.221$, $p < 0.05$). At issue would be what might have driven such an increase in disclosure.

Authors such as Lehman (1983), Ullman (1976), Guthrie and Parker (1990), Gray, Kouhy and Lavers (1995a) argue that the operations of business entities and their reporting behaviour could reasonably be expected to both influence, and be influenced by, the society in which they operate. In a sense, an organisation can be construed to be operating within a 'social contract' (Lehmann, 1983 and 1992). A firm's disclosure policies represent a response to particular groups' demands, or perceived demands, for information.

As environmental disclosures are voluntary, and if we accept that community values will affect corporate disclosure policies, then we would expect corporate disclosure policies to change as community preferences change. Consistent with this, and as previously stated in this paper, in their review of BHP's disclosure policies Guthrie and Parker (1989) found that a peak level of environmental disclosure was associated with a time in which mining, steel and oil industries became targets for criticism by environmental groups. The increased disclosures may have been made in an attempt to strategically counter the criticisms levelled by the environmental groups.

Guthrie and Parker's view that business entities may respond to, or try to counter, the criticisms made by environmental groups does not appear unreasonable. These groups undertake a number of activities that can influence a business entity's operations. For example, they may publicise companies' poor environmental performances, and this can in turn affect agreements with consumers and suppliers of the firms' factors of production. Environmental groups may also directly lobby government for changes in legislation or product standards in relation to the companies, or industries, in question.[15]

The view that environmental groups can affect the activities of firms has also been put forward by Coopers and Lybrand (1993). It states (p. 3):

> 'There are numerous examples of instances when environmental lobby groups have adversely affected business performance by highlighting poor environmental performance, whether perceived or actual. Environmental action groups are becoming increasingly influential within the community. Within the last decade memberships of such groups have swelled and their understanding of environmental issues and subsequently their credibility has increased steadily. Green groups are no longer a "fringe minority" and hence their ability to shape mainstream political and general community attitudes is considerable.'

Table 3 provides details of the changes in membership of Australia's four leading environmental groups since 1975.[16] It is interesting to note that the period representing the largest change in mem-

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[14] These years were selected because they were the years in which we were able to obtain summary data about environmental group membership.

[15] In relation to environmental groups' information sources, Tilt (1994) provides evidence that the source of information most actively sought by Australian environmental groups about company environmental performance is the companies' annual report. This may provide further incentives for firms to provide positive environmental information within their annual reports.

[16] The increase in membership of the leading environmental groups between 1975 and 1991 is approximately 1,800%. Over this same period, the Australian population has increased from approximately 14m to 17m, an increase of approximately 30%.

Table 3
Membership of Environmental Groups 1975 - 1991

	1975	*1980*	*1985*	*1988*	*1991*
ACF	8,984	8,296	13,384	14,680	21,000[a]
Greenpeace	—	—	3,000	9,000	97,000[a]
Wilderness Society	—	500	4,800	7,002	15,000[a]
WWF	—	—	—	12,000	35,000[b]
TOTALS	8,984	8,796	21,184	42,682	168,000

(ACF = Australian Conservation Foundation, WWF = World Wide Fund for Nature)

Notes:

[a] Obtained from a questionnaire sent to environmental groups (discussed in Section 5).

[b] Data provided in *The Green Pages 1991 - 1992: Directory of Environmental Groups in Australia*, published by the Australian Conservation Foundation.
All other data was obtained from *The Australian*, 9 June 1990.

bership (1988 to 1991) also corresponds to the period in which disclosure practices seemed to greatly alter. If the changes in membership are reflective of changes in community values (an untested but arguably reasonable assumption), then the firms may be reacting to these value changes. If environmental awareness has changed, then the firm could perceive a need to demonstrate its increased awareness by way of increased disclosures. That is, companies alter the disclosure policies that reflect the social implications of their activities in order to indicate that their operations are consistent with any realignment in society's social priorities and expectations.[17]

Figure 1 plots the movements in both membership of the environmental groups, and level of environmental disclosures using the data in Tables 2 and 3. It emphasises how membership of the environmental groups, and corporate environmental disclosures, have changed in the same direction, over the same period.

Lindblom's (1994)[18] exposition of legitimacy theory can usefully be applied in an endeavour to explain the concurrent increase in environmental disclosures and environmental group membership. Lindblom distinguishes between legitimacy, which is a status or condition, and legitimation, which is the process underlying that state. She defines legitimacy as:

> 'a condition or status which exists when an entity's value is congruent with the value system of the larger social system of which the entity is a part. When a disparity, actual or potential, exists between the two value systems, there is a threat to the entity's legitimacy' (as reproduced in Gray et al., 1995a, p. 54).

Such occurrences as the change in green group membership are indicative of changes in the state of legitimacy. That is, society's perceptions about what is legitimate may have changed, with greater focus being placed on issues associated with responsible environmental management. In response to the change in this 'status' or 'condition', management seeks to maintain or establish its legitimacy. In a sense management seeks congruence between the outside perceptions of its own organisation's social values, and what is deemed by society to be appropriate social conduct.

It is also interesting that in recent years a number of Australian bodies have produced environmental guides for their members to follow, which is indicative that Australian organisations are becoming more aware of the importance of environmental issues to successful business management. These guides typically provide minimal guidance in relation to disclosure policies, but do nevertheless emphasise the view that organisations should be environmentally responsible — a potential response to an apparent increase in community awareness of environmental issues. Before the early 1990s there was typically an absence in Australia of such guides.

For example, the Australian Institute of Company Directors released a booklet entitled *Environ-*

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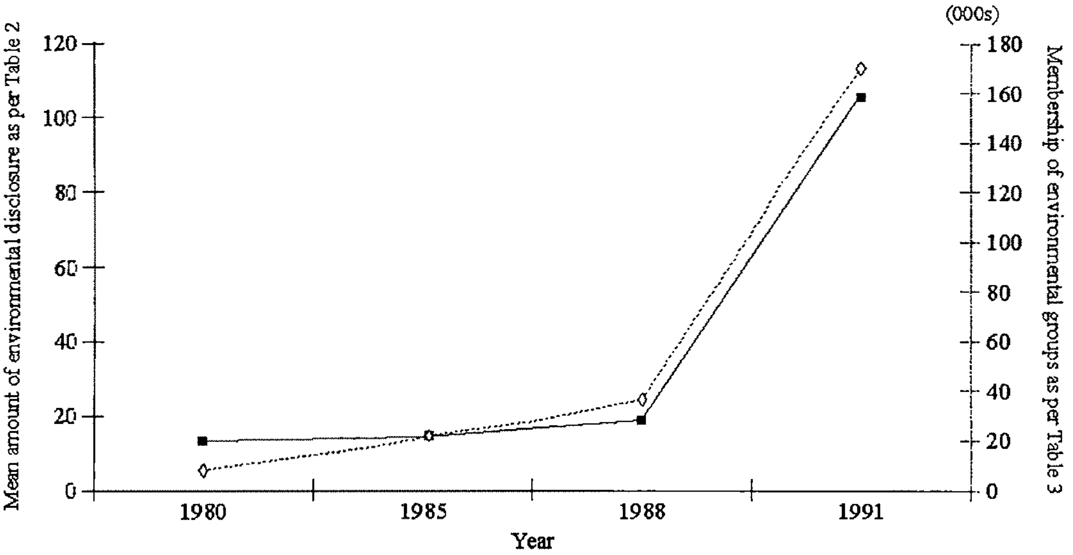
[17] The view that environmental awareness has increased in the late 1980s is not one that is isolated to the Australian experience. Macve and Miller (1993, p. 37) provide the view that within the UK 'the late 1980s and early 1990s has seen an upsurge in interest and awareness of environmental issues'.

[18] This working paper is discussed in Gray, Kouhy and Lavers (1995a, pp. 54–55).

Figure 1
An Inter-temporal Comparison of the Changes in Environmental Group Membership, and the Amount of the Environmental Disclosures



Note: ◇ = membership of environmental groups as per Table 3
■ = disclosures of environmental information as per Table 2

mental Law: A Guide for Directors (April, 1992). In the booklet, the institute urges its members to be environmentally aware:

> 'Whilst this challenge can seem to be overwhelming at first, with a proactive approach to environmental management rather than a reactive approach to incidents and the co-operation of the regulatory authorities, responsible environmental management can be achieved and can make an operation more efficient. As well as this, members of the public, including customers, will respond positively to organisations acting in an environmentally responsible and responsive way' (p. 29).

The Australian Institute of Management (1993) has explicitly considered the environment when constructing its members' code of conduct. Included in the code are the requirements that 'managers should take appropriate action to achieve the objectives of the organisation. These actions should include the effective and economic management of available resources'. The code also states that: 'Managers should recognise the interests of the community and act accordingly, this recognition to include making every endeavour to conserve the environment, balancing the rights of future generations with current economic needs.'[19]

The Business Council of Australia also released a document in 1992 recommending particular codes of conduct in relation to the management of the environment. The document emphasises that the managements of business entities should consider appropriate environmental standards and consider their performance relative to these standards. The document also suggests that management should attempt to instil a commitment to environmental responsibility within the staff of the business, the suppliers of the firm's materials, and any contractors employed.

Environmental performance guidelines have also been released by the Australian Manufacturing Council (*The Environmental Challenge, Best Practice Environmental Management*), the Institute of Engineers Australia (*Environmental Principles for Engineers*), and the Australian Chamber of Manufacturers (*The Environmental Management Handbook for Small Industry*).

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[19] While the AIM's initiative appears commendable, the enforcibility of its environmental codes appears questionable.

Environmental disclosures and environmental sensitivity

If we accept that environmental groups influence environmental reporting behaviour, then our next step is to consider whether there is an association (positive) between environmental group concerns about particular industries (which we use to derive a measure of environmental sensitivity), and the disclosure practices adopted by firms in those industries.

The more environmentally sensitive a firm's industry (that is, the greater the attention an industry is receiving from environmental lobby groups), the greater the incentive for the firm to disclose some form of positive environmental information. This may be done in an attempt to alter or shift the views held about the environmental effects of the industry at large (a process of industry legitimisation), or in an attempt to favourably differentiate the firm from other firms within the industry (a process of organisational legitimisation). This contention is consistent with the findings in Patten (1992). Patten found that following the Exxon Valdez disaster of 1989, the other oil companies in the US Fortune 500 significantly increased the level of environmental disclosures in their annual accounts. Patten stated (p. 475):

> '... it appears that at least for environmental disclosures, threats to a firm's legitimacy do entice the firm to include more social responsibility information in its annual report'.

If every firm within the industry increased its social disclosures to reflect its perceptions about community expectations then, if successful, this would conceivably have the effect of legitimising both the industry and the individual firms within the industry.

Environmental sensitivity

Environmental sensitivity could be determined in a number of ways. Previous literature may be reviewed (for example, Patten, 1991 and 1992) to provide a guide to what types of industry appear to be subject to critical review. Alternatively, on the basis that environmental lobby groups impose costs on selected industries/firms (Guthrie and Parker, 1989; Coopers and Lybrand, 1993), direct contact may be made with the environmental lobby groups themselves. This is the approach adopted in this study.

A questionnaire was used in the study, a copy of which is available from the authors on request. Each questionnaire required an office-bearer of each organisation to rate an industry, on a 0-5 scale (5 = highest, 0 = lowest), according to the extent to which their organisation had targeted the industry for its environmental activities in the last five years.

The requirement that an office bearer complete the questionnaire is based on the reasoning that such people would be best placed to assess the nationwide impact of their organisation's activities on the environment, as compared to an ordinary member or employee. Thus, it was necessarily assumed in this study that the representatives of the responding organisation did in fact take a national viewpoint of their organisation's activities when completing the questionnaire. Space was provided for the individuals to state their position in the organisation. Inspection of the returned questionnaires revealed that an office bearer had completed the questionnaire in each case.[20] To further ensure the likelihood of a national perspective being taken, the questionnaires were sent to the recognised national office of each organisation.

The industry classification used as the basis of this questionnaire was that of the *Australian Stock Exchange (ASX) Journal* 'main activities' classification for companies listed on the Australian Stock Exchange as at 31 December 1991. An initial examination of the *ASX Journal* classification revealed that 85 potential categories of industry existed. However, it was considered that the inclusion of this number of categories in the questionnaire would have made them inordinately long, and would have reduced the likelihood of their return. Thus, the overall list of industry classifications was reduced in the following way:

1. Service industries were omitted.
2. 'Diversified' activities categories were removed because of classification difficulties.
3. Categories were amalgamated where possible. For example, 'engineering' was used to represent 'heavy engineering', 'light engineering' and 'engineering contractors'.

The final list of industry classification numbered 50. Space was also provided for organisations to include any industries of concern to that group, but which were not listed in the questionnaire. Thus, while the industry list was not exhaustive, respondents were not confined to dealing only with the industries provided.

Using the questionnaires, two indices of environmental sensitivity are derived:

(i) Average Industry Environmental Sensitivity Index.

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[20] The offices held by the individuals who completed the questionnaires were president, director, executive officer, secretary/co-ordinator, project officer, environmental manager and head of corporate strategies. Again, we have assumed that the views of office bearers are consistent with the views of the other parties in the organisation.

Table 4
Top 10 Industries Ranked by the Membership Weighted Industry Environmental Sensitivity Index

Industry	*Index score*
Uranium mining	4.79
Chemicals	4.68
Coal	4.67
Transport	4.34
Oil/gas explorers	4.32
Plastics manufacturing	4.30
Oil/gas producers	4.28
Gas distributors	4.22
Paper merchants	3.99
Timber products	3.44

MEAN = [ΣRatings (0-5) for the industry by each environmental organisation ÷ Total number of environmental organisations responding].
and:

(ii) Membership Weighted Industry Environmental Sensitivity Index.

ADJ = [Σ(Rating for the industry × membership of the environmental organisation that gave the rating) ÷ Total membership of all environmental organisations that responded].

Both measures provide an overall rating, on a 0-5 scale, of environmental sensitivity for each industry, the first measure simply being the average rating for the industry for all environmental organisations. The second measure weights the ratings of each organisation according to membership. This second measure is recorded to reflect the notion of Peltzman (1976) that the greater the size of a lobby group, the greater its potential influence on the community. Further, the greater the membership of the environmental group, the more likely it is that the group's views reflects those of the community in which it operates.

Questionnaire recipients

To identify appropriate organisations, we made use of the *Green Pages 1991-1992: Directory of Environmental Groups in Australia*, as published by the Australian Conservation Foundation. Forty-one organisations were sent the questionnaire after the following selection criteria were applied. The organisations must:

(i) deal with the 'natural' as opposed to the 'built' or 'non-natural' environment;
(ii) undertake activities of a lobbying nature that impose environmental pressures on companies and government regulators;
(iii) deal with Australian environmental issues and companies; and
(iv) have a membership greater than 400.[21]

Of the 41 organisations sent a questionnaire, 22 (54%) responded. (This was after a second request had been made.) Of those that responded, one organisation refused to participate while nine of the organisations stated that they did not participate in lobbying activities. The usable responses typically came from the larger environmental groups (inclusive of Greenpeace, World Wide Fund for Nature and the Australian Conservation Foundation). Since the larger organisations are likely to have full-time salaried staff who are prepared to respond to research of this nature, perhaps this may have been expected.

A major concern in the questionnaire process was that responses should be received from organisations with memberships forming a significant percentage of the membership of all the environmental groups. Using the *Green Pages*, the total number of environmental group membership was deemed to be approximately 200,000. The membership of those groups providing usable responses amounted to approximately 165,000, which constituted about 82.5% of the membership of all environmental group members, inclusive of those groups that do not lobby.

Table 4 lists the top 10 industries ranked by the 'membership weighted industry sensitivity index'. Uranium mining was given the highest score.[22]

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[21] Though arbitrary, this cut-off is justified on the basis that small groups would not be expected to have much power or influence over other members of society (Peltzman, 1976; Stigler, 1971).

[22] The measures provided by MEAN and ADJ were reasonably consistent. We have only presented the ADJ measures in Table 4, as these take account of the membership of the green

Table 5
Correlation Between Industry Sensitivity and Amount of Positive Environmental Disclosures

		*Pearson**		*Spearman*	
Independent variables	*Predicted sign*	*Co-effic.*	*Signif.*	*Co-effic.*	*Signif.*
MEAN	+ve	0 482	$p<0.001$	0.446	$p<.01$
ADJ	+ve	0 486	$p<0.001$	0.460	$p<.01$

No. of companies = 197

* *Note*: Pearson correlation coefficients were calculated using logarithmically transformed data, with 1.0 being added to AVGPOS prior to the transformation.

Positive disclosures per industry

To test the proposition that there is a positive association between the extent of environmental disclosures and the sensitivity of the industry to which the firm belongs, requires a measure of the amount of positive environmental disclosures by industry. This measure is determined, using the sample of 197 annual reports from 1991, as follows:

AVGPOS = [Total number of positive disclosures made by firms classified by industry ÷ Number of companies in the industry that were reviewed.]

AVGPOS represents the average amount of positive disclosures by industry made by those firms that had their accounts reviewed.

Environmental sensitivity and positive environmental disclosures

Pearson product-moment correlation coefficients and Spearman rank correlation coefficients are calculated to test the association between environmental sensitivity and positive environmental disclosures (as measured by AVGPOS). These coefficients measure the strength of the association between the average amount of positive environmental disclosures made by firms in an industry (AVGPOS), and both the average measure of environmental sensitivity calculated for that industry (MEAN), and the weighted membership measure of environmental sensitivity calculated for that industry (ADJ). The results are reported in Table 5.

From Table 5 it can be seen that the Pearson product moment correlation coefficients for both measures of environmental sensitivity are in the predicted direction and significant at $p<0.001$.[23] The results of the Spearman rank correlation test (which uses the raw untransformed data) are consistent with these findings ($p<0.01$) for both measures.[24]

The results of this testing support a view that environmental disclosures are used to legitimise the operations of firms that operate in industries of concern to environmental groups.

Effects of firm size

Firm size has consistently been found to be significantly associated with voluntary social responsibility disclosures (for example, Cowen, Ferreri and Parker, 1987; Trotman and Bradley, 1981; Kelly 1979, 1981; Pang, 1982). In the light of this research, testing is carried out in this study to determine whether a relationship can be found between the amount of a firm's environmental disclosures (POS, as previously defined), and that firm's size. To test whether firm size can be used to explain a firm's decision to make environmental disclosures, and whether this effect, if found, persisted across all firms, the relationship between

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groups. As noted earlier in the paper, we have assumed that the views of the larger groups better represent community views/expectations.

[23] The dependent and independent variables used in this study had high kurtosis and skewness. This potentially invalidates the use of parametric statistics. Natural logarithmic transformation was applied to all the independent and dependent variables prior to parametric testing, and this reduced the kurtosis and skewness to acceptable levels (Foster, 1986, p 109), suggests an upper limit for skewness as +/− 0.5, for kurtosis as +/− 1.0). A number of zero values were present in the data. The relevant variables were AVGPOS, NEG and POS. The natural log of 0 is undefined. To overcome this problem the value one (1) was added to these variables prior to transformation. No transformations were applied to the data used in the Spearman correlations.

[24] Patten (1992) tested for changes in the total amount of environmental disclosure using page counts around the time of the Exxon Valdez disaster. The disclosures included both positive and negative news. As would be expected with the low amount of negative disclosures, we also found a significant association between total environmental disclosures (positive and negative combined) and environmental sensitivity.

Table 6
Results of Additional Testing: The Correlation of Positive Environmental Disclosures and Firm Size

		*Pearson**		*Spearman*	
Sample	*Predicted sign*	*Co-effic.*	*Signif.*	*Co-effic.*	*Signif.*
Overall (n = 197)	+ve	0.263	$p<0.0001$	0.264	$p<0.001$
Most sensitive (n = 34)	+ve	0.516	$p<0.002$	0.517	$p<0.01$
Least sensitive (n = 31)	+ve	−0.249	$p<0.177$	−0.059	$p<0.20$

* *Note*: The Pearson correlation coefficient was calculated after the values of POS and SALES were logarithmically transformed. The value of 1.0 was added to the POS scores prior to transformation.

firm size (in this study, measured by the entity's sales) and amount of positive disclosures is examined for three samples of firms, namely:

1. The 197 firm sample.
2. The companies in the nine[25] most environmentally sensitive industries according to the MEAN measure of environmental sensitivity (34 companies).
3. The companies in the nine least environmentally sensitive industries according to the MEAN measure of environmental sensitivity (31 firms).[26]

Pearson product moment and Spearman correlation coefficients are used to test the strength of the association between the amount of positive disclosures (POS) and firm size (SALES) for each of the three samples. As there was substantial skewness and kurtosis present in the raw data, the Pearson correlations are calculated using logarithmically transformed data. The transformations reduced the skewness and kurtosis to acceptable levels.[27] The results of testing are presented in Table 6.

The results of the Spearman rank correlations (using untransformed data) are highly consistent with the parametric results, and thus will not be discussed further. A significant and positive relationship between firm size and the amount of positive environmental disclosures made by the overall sample of firms (n = 197) is found. However, the magnitude of the Pearson correlation coefficient for the firms in the most environmentally sensitive industries (0.516) is considerably larger than that of the overall sample (0.263).[28] Furthermore, the Pearson correlation coefficient calculated for firms in the least environmentally sensitive industries (−0.249) (n = 31) is negative, and thus in the opposite direction to that predicted. This suggests that the size relationship cannot be generalised to firms in industries that are not environmentally sensitive. Only for companies operating in environmentally sensitive industries does a relationship exist between size and the amount of positive environmental disclosures. This appears reasonable as once an industry is deemed to be environmentally damaging, all things being equal, it would be assumed that larger firms create more environmental costs than smaller ones, unless they provide evidence to the contrary.

Conclusion

This paper, comprising a number of separate, but related investigations, has documented a review of corporate environmental disclosures made by Australian firms in their annual reports. The study sought to consider the objectivity of corporate environmental disclosure practices; the trend in environmental disclosures across time; and, whether environmental disclosures may be related to concern held by environmental groups about particular industries' environmental performance. The results indicate that:

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[25] We wanted to obtain approximately 30 companies from both the most and least environmentally sensitive industries. Thus, the actual number of industries (nine) from which these firms came was simply the outcome of this sample size criterion. The choice of actual sample sizes (34 and 31) was relatively arbitrary, as the purpose of the testing was merely to demonstrate that a size relationship could not be seen to persist across all industries, and thus, that size is a noisy explanatory variable of firms' decisions to disclose environmental information.

[26] Sales revenue was used as the proxy for size. A variety of measures can be used to proxy for firm size. However, measures such as sales, total assets and profits are typically found to be highly correlated (Deegan and Hallam, 1991). Thus the selection of sales is a relatively arbitrary decision.

[27] Refer back to footnote 23 for further information about the transformation process.

[28] While the significance of the relationship for the overall sample ($p<0.0001$) is greater than that of the 34-firm sample ($p<0.002$), this difference is due to the considerable difference in size (197 compared to 34) of the two samples.

(i) The amount of voluntary environmental disclosures in Australia is typically low, being only an average of 186 words for the sample companies.
(ii) The environmental disclosures are typically self-laudatory, with little or no negative disclosures being made by all firms in the study.
(iii) A general increase in environmental disclosures occurred during the period 1988 to 1991. This increase is positively associated with increases in environmental group membership.
(iv) There is a positive correlation between environmental sensitivity and the level of corporate environmental disclosure.
(v) For firms in environmentally sensitive industries, there is a positive correlation between environmental disclosures and firm size.

Taken together, the results provide further evidence that in an unregulated environment, management will be less than objective in its environmental disclosure practices. This lack of objectivity seems to increase as the environmental sensitivity of the industry increases (that is, as the sensitivity increases, the firms produce relatively more positive news). Although a number of Australian business associations have been active in releasing documents recommending greater environmental awareness by their members (for example, the Australian Business Council, the Australian Institute of Managers, and the Australian Institute of Company Directors), such apparent concern has not, as yet, translated into greater environmental disclosures.

In conclusion, if accounts users have a legitimate demand for environmental information[29], then this demand is not currently fulfilled by the environmental disclosures in Australian companies' annual reports. Consistent with Owen's (1994) perspective of UK disclosure practice, voluntary corporate disclosures in Australia do not appear to provide environmentally informative reporting.

Appendix

(a) Ex post classification of positive environmental disclosures

1. Usage of environmentally sensitive management techniques.
2. Compliance with government environmental reports and standards.
3. Pollution or waste control in the manufacturing process.
4. Merits of the company's environmental position.
5. Maintenance or implementation of a strategy to protect the environment.
6. Rehabilitation of mining sites.
7. Tree replanting schemes implemented.
8. Positive outcomes for the firm in response to governmental inquiries or public concern regarding their environmental activities.
9. Voluntary adoption of safe environmental practices.
10. Introduction of environmental audits.
11. Recycling of materials.
12. Statement of company aim or mission to protect the environment.
13. Energy-saving measures, but not solely in an efficiency context.
14. Research into, or support of, environmentally safe products and practices.
15. Usage of environmentally safe products in manufacturing.
16. Undertaking of environmental impact or assessment studies.
17. Evidence of public support/approval of the company's environmental activities.
18. Sponsor or recipient of environmental achievement awards.
19. Company in harmony with the environment.
20. Monitoring of the environment as part of the production process.
21. Establishment of wildlife preservation areas.
22. Improvements in environmental standards/facilities.
23. Review of environmental performance equipment.

(b) Ex post classification of negative environmental disclosures

1. Company in conflict with the government view on its environmental activities.
2. Admission of causing environmental, including health-related, problems for residents through the company's environmental activities.
3. Explicit admission of excessive pollutive emissions.
4. Company encountering waste disposal problems.
5. Government investigation into, and court action concerning, the company's environmental activities.
6. Acknowledgement of detrimental effects of activities on the land.

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[29] Accounts users may comprise a large cross-section of the community. As the International Accounting Standards Committee (IASC) provide in its *Framework for the Preparation and Presentation of Financial Statements* (released July 1989), financial statement users may be defined to include present and potential investors, employees, lenders, suppliers and other trade creditors, customers, governments and their agencies, and the public (para. 9).

7. Admission of environmentally-based community or media sensitivity to the industry or firm.
8. Non-compliance with regulations.
9. Admission of past problems with the company's environmental activities.

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Mining Sector Currency Risk Management Strategies: Responses to Foreign Currency Accounting Regulation

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Abstract—This study investigates the impact of Approved Accounting Standard ASRB 1012, *Foreign Currency Translation*, on the currency risk management strategies of firms in the Australian mining industry. ASRB 1012 increased the responsiveness of most mining companies' reported earnings to exchange rate movements, and it was predicted that firms would alter their capital structures in response to the increased accounting exposure. The results suggest that mining companies decreased their proportionate levels of long-term foreign debt and increased their share capital and/or reserves to mitigate the effects of the standard on their contracts. This information is useful to standard-setters seeking an awareness of the potential micro and macro-economic effects of their pronouncements.

Introduction

Accounting for foreign currency is a vexed issue for standard-setters, who often propose that the standardisation of reporting practices increases the extent to which users can rely on accounting reports for monitoring firm performance. In contrast to this view, empirical research indicates that Australian mining companies' unregulated foreign currency accounting choices are efficient for the purpose of monitoring currency risk management (Godfrey, 1994). Further, it indicates that firms only adopt non-mandatory foreign currency accounting policy prescriptions if their production and finance characteristics enable the prescribed method to provide more efficient monitoring (Bruinstroop and Godfrey, 1992). This study extends the prior research to examine changes in Australian mining companies' currency risk management strategies subsequent to the introduction of the mandatory Approved Accounting Standard ASRB 1012, *Foreign Currency Translation* (ASRB 1012).

If the introduction of a mandatory accounting standard disturbs their contracting equilibria, firms affected by the standard can mitigate at least some of the effects by changing their production/investment/financing decisions (Ball, 1988), or by altering their other accounting techniques (De Angelo, 1982, p. 174). To the extent that any one of these actions is taken, it is more efficient than the alternatives. By finding that firms altered their capital structures, this study indicates that capital structure adjustments are a relatively efficient means of mitigating the cost of regulation under certain conditions.

The most controversial aspect of ASRB 1012 is the requirement that companies recognise unrealised foreign exchange gains or losses on long-term monetary items in earnings for the accounting period when the exchange rate moves. Prior to this standard, most mining firms deferred and amortised their exchange differences.[1] ASRB 1012's effects on their reported earnings were mostly dependent on the firms' levels of foreign currency debt financing. Hence, we investigate whether changes in capital structure currency risk management strategies subsequent to the standard are related to prior levels of foreign currency debt reliance.

This study extends the prior research into the effects of foreign currency accounting regulation in at least three ways. First, we adopt an alternative to the event study method by focusing on a direct link between the mandated accounting change and changes in firms' financing decisions. In doing so, we draw on contracting theory to predict the nature of these changes and why they occurred. Thus, we aim to increase the understanding of the connection between accounting numbers and managers' contracting behaviour.

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[1] This was the method required by Australian Accounting Standard AAS 20 (1985), *Foreign Currency Translation*, para 12. While not all firms complied with this standard, evidence indicates that most mining companies used deferral and amortisation before and after its introduction (Godfrey, 1994).

Second, we concentrate on the treatment of gains and losses due to foreign currency transactions and foreign debt balances (*transaction* exposure). In contrast, US studies focus on the *translation* exposure that arises from the periodic need to restate the consolidated multinational operations of a group of companies into one common currency for external reporting purposes (Wilner, 1982; Kelly, 1982, 1985; Griffin, 1983; Gray, 1984; Brown, 1985; Ayres, 1986; Cheng, 1986; and Ziebart and Kim, 1987). ASRB 1012 did not change the reporting requirements for the translation of offshore subsidiary accounts.

The third extension of prior research is to control for inter-industry differences in the impact of the standard. Among other things, industries differ in their optimal level of exposure to exchange rate movements, their capital structures, and their levels of asset specificity. By confining the study to one industry sector, we reduce the potentially confounding effects of these differences on firms' accounting technologies.

By adopting an intra-period approach using mining firms, we increase the power of our research design. The mining industry is chosen, despite some intra-industry variation, because mining companies generally have a high exchange rate exposure. Mineral prices are usually denominated in an overseas currency, so Australian mining companies are more likely to use long-term foreign debt to hedge the effects of exchange rate fluctuations on the price of their commodities than are companies in many other industries. In fact, when ASRB 1012 was introduced, mining companies accounted for the majority of Australia's foreign currency indebtedness (Australian Bureau of Statistics, 1987). While this industry approach increases the internal validity of assessments of the standard's impact, we acknowledge that it does impair the results' external validity.

The results support the view that ASRB 1012 imposed costs on firms in the mining industry. As predicted, mining companies affected by the standard decreased their proportionate levels of long-term foreign debt financing subsequent to the standard's introduction. Further, and more significantly, mining firms that previously deferred exchange rate gains and losses increased their share capital and/or reserves more than firms that voluntarily adopted policies endorsed by ASRB 1012 prior to the standard's introduction. However, increases in their long-term domestic debt levels over the test period did not occur.

In section 2 we provide institutional background to foreign currency accounting standards setting in Australia. Section 3 develops the hypotheses, while section 4 outlines the research design, data collection methods and statistical tests. The results are reported and discussed in section 5. Section 6 summarises and concludes.

Institutional background

Until the 1970s, the Australian accounting profession displayed little concern with the accounting for foreign exchange rate gains and losses on long-term monetary items. However, interest increased in the 1970s after the following economic events: the breaking of the links between the Australian dollar and the British pound in 1971 and between the Australian dollar and the US dollar in 1974; devaluations of the Australian dollar in 1974, 1983 and 1985; removal of most foreign exchange controls in 1983; and Australian currency flotation in late 1983 (Corsi, 1987, p. 3). Media coverage of the substantial currency losses following the 1985 devaluation[2] and the recognition that companies did not report currency transactions consistently (Kenley, 1978; Wise and Wise, 1985) also highlighted a perceived need for government and professional intervention.

The first foreign currency accounting exposure draft (ED) (1973) recommended that unrealised gains and losses be reported as an element of shareholders' equity, while realised gains and losses be reported in earnings.[3] In June 1979, the second ED[4] recommended that companies disclose their foreign exchange gains and losses in the balance sheet as deferred income or expenses and amortise the differences in earnings. This ED received 70 submissions, the most that had then been received in response to any ED. Of the 34 submissions on the specific issue of accounting for foreign exchange differences on long-term monetary items, 20 responses favoured the deferral methods over immediate recognition of the currency gains and losses in earnings (Uther, 1983, p. 58). The lobbying for deferral methods suggests that adoption of ASRB 1012's immediate recognition requirements was costly for the firms. The recommendation for deferral and amortisation continued into the third exposure draft.[5]

In October 1985, the National Councils of the Australian Society of Accountants (ASA) and the Institute of Chartered Accountants in Australia

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[2] For a comprehensive review of these, see Corsi (1987, footnote 29).

[3] *Translation of Amounts in Foreign Currencies* (September 1973).

[4] *Translation of Foreign Currency Transactions and Foreign Currency Financial Statements in the Context of Historical Cost Accounting.*

[5] *Foreign Currency Translation* (September 1983).

(ICAA) released AAS 20 (1985). The professional accounting standard endorsed the deferral and amortisation method for long-term foreign currency borrowings. However, a submission to the Accounting Standards Review Board (ASRB) for approval of the standard as mandatory for companies, did not receive the Board's approval. Therefore, compliance with the standard was voluntary.[6] Pound (1987) cites evidence of non-compliance and divergence in accounting preferences. A central issue in the debate between the profession and the ASRB concerned the treatment of unrealised foreign exchange gains and losses on long-term monetary items (Killen, 1987). Of the 32 responses to ASRB Release 411 that specifically called for comment on the accounting requirements for long-term monetary items, 19 favoured the deferral and amortisation of exchange rate differences, eight favoured immediate recognition and five passed no comment on the issue.

Nevertheless, on 3 April 1987, the ASRB announced its intention to require companies to immediately recognise their exchange rate gains and losses on long-term monetary items (Media Release 87/1). The stated primary reason was that the losses and gains that resulted from the deferral methods did not represent 'usual forms of assets and liabilities'. On 10 September 1987, the AAS 20 provisions were brought into line with the ASRB recommendations. The principal amendment required companies to immediately recognise unrealised exchange gains and losses on long-term foreign currency monetary items in reported earnings.

Theory and hypothesis development

In a regulated accounting environment, a mandated accounting standard restricts the set of accepted accounting procedures and disturbs a firm's contracting equilibrium to the extent that it affects the monitoring and specification of existing and future contracts (Watts and Zimmerman, 1986, p. 219). Managers opposing the standard are likely to mitigate its impact on the measurement of reported accounting numbers by altering the firm's contracting decisions if that response is more efficient than alternatives.

Managers are unlikely to alter other accounting techniques to offset the negative effect of immediate recognition on earnings because the uncertainty and variability in exchange rate movements makes the accounting impact on earnings equally uncertain and variable. Therefore, this study focuses on the contracting consequences of ASRB 1012, as evidenced by changes in the firms' financing decisions when the standard was introduced. Although firms' production, investment and financing decisions are interrelated (Vickers, 1968), adjustments to their production and investment strategies are not expected, because of the higher costs involved in changing the extant technologies.

Debt Contracts

Australian evidence indicates that the accounting procedures required to comply with debt covenants are typically those that prevail at the date of calculation rather than at the date of issuance of the debt (Whittred and Zimmer, 1986). Hence, a mandated accounting change restricts the firm's optimal contracting technology to the extent that it relates to the accounting numbers used in the firm's contracts.

ASRB 1012's requirement to immediately recognise unrealised exchange rate gains and losses on long-term monetary items increased the volatility of reported net income and, hence, the risk of violating restrictive debt covenants. Although the specific nature of the debt covenants in the Australian mining industry is not formally documented[7], anecdotal evidence from the annual reports of mining companies included in the test sample indicates that debt restrictions are stated in the form of debt/equity, and interest coverage ratios. Variations in net income impact on these ratios either directly or indirectly by virtue of the accounting equation.

Management Compensation Contracts

Management compensation plans can reduce the agency costs of equity by allowing managers to share in firm profits in excess of a target level (Jensen and Meckling, 1976). This is probably also true of informal rewards to management, e.g. promotion, or salary revisions. Managers' preferences for volatile or stable income-generating accounting policies are difficult to determine in the absence of clear evidence on the content of Australian management compensation contracts. Moses (1987, p. 364) argues that managers incorporate the present value of their future compensation payments in their decisions to adopt stable or volatile income-generating accounting procedures. Hence, managers have incentives to avoid fluctuations in reported earnings because low income depresses the bonuses of the current period, while high income reduces future bonuses by raising future compensation thresholds.[8] Moses' findings are supported by Gaver, Gaver and Austin (1995) who, in contrast to Healy (1985), find evidence of income smoothing by firms whose earnings fall below bonus compensation plan thresholds.

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[6] While there is provision in the rules of both the ASA and the ICAA to penalise non-compliance, there is no evidence of this action being taken (Bruinstroop and Godfrey, 1992). In any case, professional bodies only have disciplinary powers over their own members (Parker, 1986, p. 4).

[7] Frost and Bernard (1989) discuss the covenants of US mining companies, but surveys by Whittred and Zimmer (1986) and Stokes and Tay (1988) examine the listed public debt issues of Australian industrial and commercial companies only.

Political Visibility

In Australia it can be argued that mining companies are highly exposed to political costs in the form of freight tax charges, and other such regulation.[9] These firms undertake most of the corporate sector's foreign currency transactions (Eddey, 1985, p. 23). ASRB 1012 therefore contributes to their political cost exposure by increasing reported earnings volatility.

Although political cost implications affect all periods, it is periods of high profitability that are likely to attract the most adverse attention. Hence, the managers of companies affected by ASRB 1012 have incentives to avoid the variable net income streams that immediate recognition encourages, because the periods of high profitability attract costs that are then effective in all periods.

Effect of ASRB 1012

Around the introduction of ASRB 1012, most mining firms with foreign currency long-term debt used it as a natural hedge of export earnings. In fact, Bruinstroop and Godfrey (1992) found that all firms in their sample of resource companies with foreign currency long-term debt borrowed in the same currency as their export earnings were denominated. The market for synthetic hedges was not well developed[10], although forward sales were sometimes hedged with forward contracts, particularly in the coal and steel industries. Where synthetic hedges were used, they applied to specific transactions, whereas foreign debt was often used as a natural hedge of a general exposure. This was particularly so in relation to the assets used to generate future, as yet uncontracted, sales revenues.

The more their long-term foreign debt, the more ASRB 1012 introduced volatility in the reported net income of firms previously using deferral accounting methods (affected firms). Moreover, the greater the variation in their reported net income, the greater the contracting and political costs that firms incurred as a result of their compliance with ASRB 1012. Hence, within the affected firms, the compliance costs are likely to have varied with firms' levels of long-term foreign debt. The higher their reliance on long-term foreign debt, the more likely firms are to have decreased their reliance on long-term foreign debt to mitigate the contracting and political costs. On this basis, the following hypothesis applies to firms that used deferral methods prior to ASRB 1012 ('standard-affected' firms).

H1: The greater their reliance on foreign currency long-term debt finance prior to ASRB 1012, the greater the reduction in 'standard-affected' firms' reliance on foreign currency long-term debt financing subsequent to ASRB 1012 adoption.

If firms reduced their levels of long-term foreign currency debt in response to ASRB 1012, then it is feasible that they compensated for the reduction in their capital by increasing their other methods of long-term financing. The following hypotheses predict how firms substituted alternative finance for foreign currency long-term debt.

Increasing domestic long-term debt involves substituting debt for debt. However, the currency risk exposure is altered. The use of domestic debt increases economic currency risk because the currency risk from assets is left exposed relative to the debt. The following hypothesis is posed as a possible reaction to the standard, because it is intuitively appealing that firms would aim to maintain their capital structures by replacing debt with debt. However, an alternative (null) hypothesis that is even more plausible in the context of this study predicts that domestic debt reliance remained unaltered because to borrow domestically increases the very economic exposure the firms had tried to avoid. Consistent with hypothesis 1, we state the following hypothesis in the positive form.

H2: The greater their reliance on foreign currency long-term debt prior to ASRB 1012, the greater the increase in 'standard-affected' firms' reliance on domestic long-term debt financing subsequent to ASRB 1012's introduction.

Firms could also have avoided some exchange rate volatility of reported earnings by financing their domestic investments through share issues and/or increases in reserves.[11] The added advantage of this financing decision as a method of compensating for the reduction in long-term foreign debt is that debt covenant ratios such as interest coverage and leverage are not adversely affected by the change in long-term financing.

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[8] This argument assumes that management compensation committees use current period earnings as a threshold standard for future period bonus payments.

[9] See Sidhu and Whittred (1993) for discussion of the political exposure of Australian mining companies to increased taxation burdens. During the late 1960s and early 1970s the mining sector was particularly vulnerable to increased taxes. Its healthy profit growth during the 1968–1974 mining boom caused public awareness of shifts in relative taxation burdens from the corporate to the private sector. Subsequent political pressure resulted in the removal of many taxation benefits previously enjoyed by the mining sector. The vulnerability did not cease with removal of taxation exemptions for gold mining profits. Instead, it moved to issues such as levels of government freight charges and royalties for use of crown land.

[10] The Australian derivatives market developed most in the early 1990s (Reserve Bank of Australia, 1994).

> **H3: The greater their reliance on foreign currency long-term debt finance prior to ASRB 1012's introduction, the greater the increase in 'standard-affected' firms' subsequent reliance on share capital and/or reserves financing.**

Research method

The hypotheses predict that mining companies affected by ASRB 1012 reacted to its introduction by reducing their reliance on foreign long-term debt and increasing their reliance on domestic long-term debt and/or share capital and reserves. The greater the contracting and political costs imposed by the standard, as indicated by the ratio of firms' long-term foreign debt to total long-term finance in 1986, the greater the change in their subsequent financing decisions. We employ a quasi-experimental design to test the hypotheses because of the lack of experimental control over the assignment of the firms to the comparison groups (Campbell and Stanley, 1963).

Sample Selection

The 30th edition of Jobson's *Mining Year Book* lists all the major 679 quoted and non-quoted mining, oil and exploration companies in Australia as at 31 January 1987. The final sample consists of companies from the list that meet the sample selection criteria described below and listed in Table 1. Table 1 also lists the number of companies deleted at the end of each selection procedure.

1. The company must have a place of incorporation or a head office in Australia. Other companies (n = 5) are outside the jurisdiction of the National Companies and Securities Commission, and are therefore unaffected by ASRB 1012's promulgation.
2. The company must not have been subject to a takeover bid that resulted in transfer of the company from the mining to the industrial boards of the Australian Stock Exchange, or the financial affairs of the target company being reported as part of the bidding company's annual reports (33 firms deleted).
3. Exploration and development of natural gas was not the sole mining activity. Gas companies (n = 1) are likely to finance their activities with domestic rather than foreign debt, since gas is an Australian-priced commodity.
4. Annual reports for 1986 and 1988 were available on the Australian Graduate School of Management microfiche (321 firms deleted). Attempts to increase the sample size by contacting firms directly for copies of their accounts were unsuccessful because most firms were inactive, did not have available accounts for both 1986 and 1988, or were unwilling to provide them. Further, some companies had since failed or been taken over. Of those companies providing accounts, none disclosed sufficient details regarding any foreign currency dealings for the firms to be included in the sample. Including only firms large enough to be on the microfiche database increases the power of tests, since it reduces the likely impact of variation in size as a confounding factor.
5. The company separately disclosed its levels of foreign and domestic long-term debt and disclosed its foreign currency accounting policies in 1986 and 1988 (286 firms deleted). During the selection period, separate disclosure of debt in different currencies was mandatory. Thus, it seems reasonable to believe that companies deleted at this stage had no material foreign currency debt to report. Many, in fact, had no debt at all. Some firms reported foreign currency accounting policies but did not appear to have foreign currency debt. This appears to be due to the automatic inclusion of policies from prior periods, regardless of their relevance to current period financing.[12]
6. The available financial statements and notes were legible (two firms deleted).

Application of the above criteria produced the sample of 31 companies[13] listed in Table 2. Twenty-four firms used deferral methods; seven used immediate recognition prior to ASRB 1012 introduction. Using both public sources and private access to government sources unavailable to us, Bruinstroop and Godfrey (1992) found only 40 Austra-

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[11] These reserves exclude foreign exchange fluctuation reserves since they depend on exchange rate movements. Equity investment neutralises currency risk exposure to bankruptcy risk in that no repayments are committed in any currency, and returns (dividends) can be varied to suit currency-influenced changes in asset values. Also, to the extent that the financing is of assets that are not producing sales (e.g. pre-production), and whose (currency-affected) values are not restated through earnings, exchange rate effects are withheld from *reported* earnings, thus the *reported* earnings are less exposed to exchange rate movements.

[12] Discussions with five executives confirmed this situation in their firms' cases.

[13] One company in the sample continued to use the deferral method of accounting in 1988. The company's non-compliance with ASRB 1012 suggests that it undertook alternative costly adjustments to those hypothesised. However, the company is retained in the sample because it meets the specified selection criteria. Its inclusion biases against finding a significant change in firms' financing decisions.

Table 1
Sample selection

Population of mining companies identified in *Jobson's Mining Year Book* (30th edition)		679
Selection criteria	*Firms deleted*	
1. Incorporation in Australia	5	
2. Not subject to a takeover bid	33	
3. Not primarily a gas company	1	
4. 1986 and 1988 annual reports contained on Australian Graduate School of Management Annual Report File	321	
5. Foreign currency accounting policy reported in 1986 and 1988	259	
6. Long-term foreign debt reported in 1986 and/or 1988	10	
7. Foreign and domestic debt classification available	17	
8. Legible annual reports	2	648
Total sample		31

lian resource companies with foreign currency long-term debt between 31 October 1985 and 31 December 1987. They concluded that this was probably the population of firms with foreign currency long-term debt during that period. As such, the sample of 31 probably represents slightly more than 75% of the population.

Test Period

We collected data from 1986 and 1988 annual reports to allow comparisons of companies' financing decisions before and after ASRB 1012's statutory enforcement on 1 January 1988. Although 1986 coincides with the recommendation of the deferral and amortisation method under AAS 20 (1985), the findings of Bruinstroop and Godfrey (1992) indicate that resource firms did not adopt the voluntary accounting standard unless it was contractually efficient to do so. Data are not collected from the 1987 annual reports since firms' financing decisions in 1987 may reflect their anticipation of ASRB 1012's introduction in October 1987 rather than their optimal accounting policy.

Research Design

We employ a variation of the non-equivalent control group research design (Campbell and Stanley, 1963, pp. 47–50). Companies using immediate recognition prior to ASRB 1012 constitute the control group, while those using deferral methods make up the treatment group.

It is impossible to ensure an ideal group prior to ASRB 1012. However, while variables such as long-term survivorship can affect firms' financing if they play a part in assessing credit worthiness or investment potential, maturation is an unlikely internal validity threat in this study because there is no significant difference between the dates of incorporation of the deferral and immediate recognition firms. The selection criteria introduce a survivorship bias in that the analysis covers only those companies that survived the test period, but this affects both groups. The sample selection procedures caused no disproportionate differences between deletion rates within the two groups. Further, while firms' financing decisions for the financial year ending in 1988 are likely to be affected by the stock market crash, the crash would have affected the financing decisions of both the control and treatment firms.

Table 3 reveals that there were no significant differences in the key financial attributes of the control and experimental group in 1986 at $\alpha = 0.05$ (two-tail).[14] Thus, while equivalence cannot be assured, the fact that the groups do not differ significantly on size, leverage, interest cover, profit and profitability measures indicates that the attributes and their associated contracting incentives did not drive differences in the groups' reactions to ASRB 1012. Further, the two groups of firms do not differ significantly in their mining industry sub-group classification (see Table 2).

This is consistent with prior findings that *traditional* contracting variables (leverage, size and profitability measures) have been unassociated with foreign currency accounting policy choices for a larger sample of mining and non-mining firms (Godfrey, 1992). Instead, prior research has found associations between foreign currency long-term debt accounting policy choice and the extent of firms' exchange rate risk exposures, their account-

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[14] 'Sales' is significantly different for one-tailed tests ($a < 0.05$), but since other size measures are not (e.g. total assets, total revenue), it is difficult to interpret this result.

Table 2
Sample Firms and their Industry Classification, 1986

Deferral Firms (n = 24)	*Industry*
Ampol Exploration Limited	Oil and gas
Australian Consolidated Minerals Limited	Gold
Australian Gas Light Company	Oil and Gas
The Bell Resources Limited	Diversified
Bond Corporation Holdings Limited	Entrepreneur
Boral Limited	Building materials
Bougainville Copper Limited	Other metals
Bridge Oil Limited	Oil and gas
Broken Hill Proprietary Company Limited	Diversified
The Comalco Limited	Other metals
CRA Limited	Other metals
CSR Limited	Building materials
Golconda Minerals NL	Gold
Great Australian Resources NL/Transglobal Resources	Diversified
Kidston Gold Mines Limited	Gold
MIM Holdings Limited	Other metals
Metals Exploration Limited	Finance and investment
North Broken Hill Holdings Limited	Diversified
Renison Goldfields Consolidated Limited	Other metals
Santos Limited	Oil and gas
Vamgas Limited	Oil and gas
Western Australian Diamond Trust	Other metals
Western Mining Corporation Holdings Limited	Other metals
Woodside Petroleum Limited	Oil and gas
Immediate Recognition Firms (n = 7)	
Aberfoyle Limited	Other metals
Allied Queensland Coalfields Limited	Solid fuels
Ashton Mining Limited	Other metals
Energy Resources Limited	Oil and gas
Energy Resources of Australia Limited	Oil and gas
Pancontinental Mining Limited	Diversified
Pioneer Concrete Services Limited	Gold

Source: Australian Stock Exchange, *Industry Classification*

ing policies for overseas subsidiaries, and their stage of operations (exploration and development, operating, etc.) (Godfrey 1992, 1994).

To investigate these associations for the firms in the current sample is beyond the scope of this study. However, it should be noted that if the firms' voluntary policy choices were efficient, as assumed by this study, they would have reduced monitoring costs or otherwise reduced transaction costs. Thus, there ought to be systematic associations between the voluntary choices and firms' underlying financing investment and/or operating attributes related to those costs, as found by the prior research.

Explanatory Variable

The explanatory variable proxies for the contracting and political cost effects of ASRB 1012. It is a proportionate measure of firms' long-term foreign currency debt to total long-term finance in 1986. Table 4 summarises the predicted directions of its relation to the endogenous variables.

The proportions of firms' long-term foreign currency debt to total long-term finance in 1986[15] represent the extent to which the introduction of ASRB 1012 imposed contracting and political costs on firms. Long-term foreign currency debt is standardised as a percentage of total long-term finance since differences in firm size confound the direct comparisons of actual dollar amounts. Total long-term finance comprises the sum of long-term debt, share capital and the reserves that are not affected by foreign currency fluctuations. The denominator excludes foreign exchange reserves because their balances are affected by firms' prior

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[15] For a discussion on the justification of the test period, see subsection 'Test Period'.

Table 3
A Comparison of Control and Experimental Firms' 1986 Financial Attributes

	Experimental group	*Control group*	*Experimental group*	*Control Group*
	Total assets		*Total sales*	
n	24	7	23	7
Minimum	8,964	17,222	1,104	0
Maximum	16,549,000	2,067,435	8,503,322	2,982,392
Mean	2,274,609	583,997	1,190,772	464,131
Median	1,224,226	319,253	337,254	42,090
Standard deviation	3,601,422	720,473	1,962,630	1,111,121
Kurtosis	8.584	0.656	6.775	2.155
Student t (two-tailed p)	− 1.221	−0.232	− 0.928	−0.361
M-W U (two-tailed p)	55	−0.171	46	−0.091
	Total revenue		*Interest cover (Operating profit before tax)/ interest*	
n	22	7	23	6
Minimum	1,104	2,226	− 2	− 9
Maximum	8,683,155	3,032,055	385	10
Mean	1,344,591	476,545	19	1
Median	294,963	47,669	1.226	2.412
Standard deviation	2,106,983	1,127,590	79	6
Kurtosis	4.962	2.155	17	0.133
Student t (two-tailed p)	− 1.035	−0.310	− 0.526	−0.603
M-W U, (two-tailed p)	53	−0.221	79	−0.590
	Leverage (Total liabilities/ total assets)		*Return on assets (Operating profit before tax/ total assets)*	
n	24	7	24	7
Minimum	0.124	0.028	− 0.101	− 0.057
Maximum	0.808	0.527	0.429	0.111
Mean	0.517	0.390	0.054	0.062
Median	0.526	0.454	0.047	0.077
Standard deviation	0.192	0.177	0.096	0.055
Kurtosis	− 0.782	0.556		1.329
Student t (two-tailed p)	− 1.568	−0.128	0.195	−0.846
M-W U (two-tailed p)	53	−0.143	111	−0.202
	Operating profit before tax		*Net profit afer tax*	
n	24	7	24	7
Minimum	− 16,553	− 12,780	− 138,600	− 7,933
Maximum	988,203	190,515	988,203	50,424
Mean	112,367	47,734	51,535	14,167
Median	34,071	24,504	4,183	1,322
Standard deviation	213,743	72,659	213,843	21,123
Kurtosis	9.967	0.103	13.778	− 0.921
Student t (two-tailed p)	− 0.779	−0.442	−0.456	−0.652
M-W U (two-tailed p)	72	−0.571	87	−0.887
	Total liabilities		*Total debt*	
n	24	7	24	7
Minimum	4,181	490	4,182	481
Maximum	9,829,070	1,088,833	8,769,937	911,037
Mean	1,394,791	273,051	1,156,224	228,790
Median	529,650	166,763	349,143	157,157
Standard deviation	2,247,464	377,038	2,058,619	317,504
Kurtosis	6.770	1.370	6.596	1.264
Student t (two-tailed p)	− 1.300	−0.204	− 1.174	−0.250
M-W U (two-tailed p)	53	−0.143	55	−0.171

Table 4
Predicted Association Between Variables

Variable	*Hypothesised direction*	*Definition*
Dependent variables		
FT88-86 Hypothesis 1	−	[(Long-term foreign debt)$_{1988}$/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Long-term foreign debt)$_{1986}$/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
DT88-86 Hypothesis 2	+	[(Long-term domestic debt)$_{1988}$/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Long-term domestic debt)$_{1986}$/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
SRT88-86 Hypothesis 3	+	[(Shareholder's funds − foreign currency reserves$_{1988}$)/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Shareholders' funds − foreign currency reserves)$_{1986}$/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
Independent variable		
FT86		[(Long-term foreign debt)$_{1986}$/(Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]

foreign currency accounting policies. Similarly, the denominator excludes reported net income, since it is also affected by the foreign currency accounting policies.

To fall within the definition of long-term foreign debt, the debt must have an original period to maturity of at least 12 months and be denominated in a foreign currency. These criteria apply regardless of the debt's actual settlement date.

Dependent Variables

The dependent variables represent the changes in firms' long-term financing subsequent to the introduction of ASRB 1012. The use of proportionate measures introduces potential numerator and denominator effects, which can confound the test results. For example, a percentage decrease in the proportion of firms' long-term foreign debt to total long-term finance over the test period may be caused by increases in the firms' total long-term finance rather than the predicted decrease in their foreign long-term debt. To fully analyse the results, they are interpreted in both percentage and absolute terms.

To test whether firms increased their levels of long-term domestic debt[16], the tests employ a proportionate measure of long-term domestic debt to total long-term finance. This measure takes into account the effects of changes in firm size and inflation. Long-term domestic debt encompasses both secured and unsecured bank loans and lease finance commitments with terms to maturity of at least 12 months. The liabilities represent obligations that the firms must meet in order to remain viable. Long-term accruals, provisions and trade creditors are excluded, since these are generally outside the scope of firms' long-term financing decisions.

In assessing the effect of ASRB 1012 on mining companies' decisions to use equity funding, total shareholders' funds as a proportion of total long-term finance is inappropriate, since it includes firms' retained profits and thus the effects of different accounting treatments of exchange differences. Therefore, this study excludes retained profits from share capital and/or reserves.[17]

Bonus issues are signalling devices that firms use to convey information to the market (Ball, Brown and Finn, 1989). They do not increase firms' long-term finance and, hence, are excluded from the measure of the dependent variable. Rights issues are also signalling devices. However, they are included within the dependent variable because they represent increases to the level of firms' long-term finance. Share issues to new shareholders are within the definition of share capital because they increase long-term finance.

AAS 20 (1985) allowed firms to transfer their transactions' foreign exchange gains and losses to

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[16] It is also possible that firms increased their long-term domestic debt levels to facilitate increases in their total long-term debt finance while maintaining their existing long-term foreign debt levels.

[17] Ideally, the comparison of firms' long-term financing decisions should be on the basis of data that has been converted to one accounting method. While this negates the effect of differential accounting treatments, it is not feasible in this study, given data constraints.

Table 5
Descriptive Statistics for Independent Variables

	FT88-86(H_1)	*DT88-86(H_2)*	*SRT88-86(H_3)*	*FT86*
Panel A: All companies				
n	31	31	31	31
Minimum	−0.630	−0.480	−0.340	0.001
Maximum	0.470	0.420	0.630	0.740
Mean	−0.043	−0.007	0.048	0.290
Std. dev.	0.219	0.156	0.224	0.216
Skewness	−0.527	−0.100	0.638	0.436
Kurtosis	1.991	3.106	1.015	−0.764
Panel B: Deferral firm				
n	24	24	24	24
Minimum	−0.630	−0.480	−0.340	0.001
Maximum	0.470	0.420	0.630	0.740
Mean	−0.071	−0.013	0.081	0.315
Std. dev.	0.219	0.162	0.226	0.222
Skewness	−0.694	−0.322	0.696	0.394
Kurtosis	2.349	3.131	0.997	−0.943
Panel C: Immediate recognition firms				
n	7	7	7	7
Minimum	−0.150	−0.130	−0.330	0.001
Maximum	0.330	0.310	0.140	0.460
Mean	0.056	0.011	−0.067	0.204
Std. dev.	0.201	0.142	0.185	0.182
Skewness	0.440	1.433	−0.240	0.072
Kurtosis	−1.545	1.063	−0.670	−1.458

Dependent variables

FT88-86	[(Long-term foreign debt)$_{1988}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Long-term foreign debt)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
DT88-86	[(Long-term domestic debt)$_{1988}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Long-term domestic debt)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
SRT88-86	[(Shareholders' funds − foreign currency reserves$_{1988}$) / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Shareholders' funds − foreign currency reserves)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
Independent variable	
FT86	[(Long-term foreign debt)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]

a foreign currency reserve. Although ASRB 1012 now requires that firms recognise these exchange differences in earnings, a foreign currency reserve account still exists for those companies with self-sustaining foreign operations. ASRB 1012 (para. 53) states that exchange differences arising from the translation of self-sustaining operations must be recognised in a foreign currency translation reserve. For the purposes of the study, we exclude the foreign currency reserve account, since it is subject to exchange rate fluctuations. Once again, the rationale for the exclusion is on the basis of the differential accounting treatments of the foreign exchange gains and losses on long-term monetary items.

Results

Descriptive Statistics

Table 5 summarises the descriptive statistics for the test variables. Panel A tabulates the variables for all companies regardless of their 1986 foreign currency accounting policy. The relatively large skewness and kurtosis coefficients[18] for some variables indicate non-normality. Panels B and C categorise firms according to their 1986 foreign currency accounting policy. It is important to note that deferral firms reduced their reliance on foreign currency long-term debt subsequent to ASRB 1012; whereas immediate-recognition firms increased theirs. Also, the deferral firms increased their reliance on shareholders' funds whereas immediate-recognition firms decreased theirs. The only means not in the predicted direction are for changes in reliance on domestic long-term debt. Once again, the skewness and kurtosis coefficients for some variables suggest non-normal distributions.[19] Normal probability plots of the dependent and independent variables support the normality implications of the skewness and kurtosis coefficients.

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[18] For samples of 20 to 100 observations, Foster (1986, p. 106) suggests that variables with a skewness coefficient of less than −0.5 or greater then 0.5 and/or a kurtosis coefficient of less than −1.0 or greater than 1.0 may not be normally distributed.

We employ both parametric and non-parametric test procedures to examine the differences between the central locations of the test variables. We rely on the results of the Student's t-test where the skewness and/or kurtosis coefficients indicate that the population distributions are normal. Conversely, we rely on the results of the Mann-Whitley U tests where the skewness and/or kurtosis coefficients indicate that the population distributions are non-normal.

Regression Testing

Hypothesis testing utilises an ordinary least squares regression model to determine whether a relation exists between firms' foreign debt levels in 1986 and the subsequent changes in their financing decisions.[20] The results appear in Table 6. The model assumes that managers aim to maintain a target capital structure. Thus, it assumes that a random walk model provides a reasonable approximation of firms' capital structure changes over time.[21] There are various reasons why firms might change their capital structures by substituting debt and equity (see Barclay, Smith and Watts, 1995). However, the fact that the control and experimental groups changed capital structures in opposite directions, despite their similar financial characteristics prior to ASRB 1012 (including leverage and interest cover) provides some control for capital structure changes motivated by expectations of currency or commodity price movement effects on the firms or other factors, other than the requirement to change accounting policies.

Private sector net foreign currency debt increased each year from 30 June 1985 to 30 June 1989 (Australian Bureau of Statistics, 1991, Table 5), and the Australian currency generally appreciated against the US dollar and major trading currencies (including the Trade Weighted Index) during 1987–1988 (Reserve Bank of Australia, 1990, S 81). Thus, on average, across the private sector, expectations of a declining currency did not prompt firms to reduce their reliance on foreign currency debt. There is no reason to expect that the control and experimental mining companies' expectations were different. Further, commodity prices were increasing at the time (Reserve Bank of Australia, 1994, p. 7 and 1988, p. 53), so firms responding to this trend would be unlikely to switch from debt to equity because of expectations of future declines in cash flows.

In contrast to the incentives from currency appreciation and commodity price increases to increase foreign debt, the emerging derivatives market could have provided some incentives for firms to move away from natural hedging of specific synthetic hedges. As previously mentioned, this effect is likely to have been minor during the period under consideration. As such, the naive expectations model is likely to provide a reasonable approximation of firms' capital structures in the absence of ASRB 1012.

There appears to be no reason for control and experimental firm managers' expectations to differ, and the groups do not differ significantly on key financial attributes in 1986 (Table 3). Hence, comparisons between these groups should control for expectations effects and incentives.

The first regression in Table 6 tests hypothesis 1. The explanatory power of firms' 1986 reliance on long-term foreign debt as the independent variable is over 35% ($R^2 = 0.365$). The coefficient result is in the hypothesised direction and is signifi-

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[19] For deferral firms, the large skewness coefficients are for the FT88–86 and SRT88–86 variables, while the large kurtosis coefficients are for the FT88–86 and DT88–86 variables. For immediate recognition firms, the large skewness coefficient is for the DT88–86 variable, while the large kurtosis coefficients are for the FT88–86 and FT86 variables.

[20] The relatively large skewness and kurtosis coefficients and normal probability plots indicate that some variables are not normally distributed. Where the normality assumption is violated, a common alternative to the ordinary least squares regression model is the log linear model (Newbold, 1984, p. 568). Linearity is not problematic for the regression models for hypotheses 1 and 3. However, lack of linearity may be driving the results for hypothesis 2. Additional loglinear testing yielded results consistent with those of the linear model. Heteroscedasticity is not present. For completeness, the regression models for deferral firms were rerun without two outliers. The regression coefficients for hypotheses 1 and 3 decrease in significance ($p = 0.010$ and $p = 0.011$ respectively). In absolute terms, the explanatory power decreases for all significant independent variables. The independent variables in hypothesis 1 and 3 explain approximately 25% and 24% of the variations in their respective dependent variables.

[21] Alternative expectations models, such as means-reverting models, generally require additional data that lead to an overfitting of the regression within this sample of mining companies. Furthermore, within mining companies, the existence of foreign debt indicates the presence of assets in place. Thus, expectations models incorporating changes in investment (asset) structure are unlikely to yield further insights.

Table 6
OLS regression tests of association between firm reliance on foreign currency long-term debt and subsequent reactions to ASRB 1012

Variable	*Coefficient*	*Standard Deviation*	*t*	*p (one-tail)*
Hypothesis 1 - Dependent variable: FT88-86 (Change in reliance on long-term foreign debt)				
Constant	0.117	0.064	1.817^{b}	0.042
FT86	−0.597	0.168	−3.554^{a}	0.001
Adjusted multiple R^2 = 0.365, F = 12.634, p* = 0.001, n = 24				
Hypothesis 2 - Dependent variable: DT88-86 (Change in reliance on long-term domestic debt)				
Constant	−0.022	0.060	−0.371	0.357
FT86	0.030	0.156	0.196	0.423
Adjusted multiple R^2 = 0.002, F = 0.038, p* = 0.423, n = 24				
Hypothesis 3 - Dependent variable: SRT88-86 (Change in reliance on shareholders' funds)				
Constant	−0.096	0.069	−1.381^{c}	0.091
FR86	0.562	0.181	3.101^{b}	0.003
Adjusted multiple R^2 = 0.304, F = 9.614, p* = 0.003, n = 24				

Dependent variables	
FT88-86	[(Long-term foreign debt)$_{1988}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Long-term foreign debt)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
DT88-86	[(Long-term domestic debt)$_{1988}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Long-term domestic debt)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
SRT88-86	[(Shareholders' funds − foreign currency reserves$_{1988}$) / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1988}$] − [(Shareholders' funds − foreign currency reserves)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]
Independent variable	
FT86	[(Long-term foreign debt)$_{1986}$ / (Long-term debt + shareholders' funds − foreign currency reserves)$_{1986}$]

*One-tailed test

a: significant at p = 0.01; b: significant at p = 0.05; c: significant at p = 0.10

cant at the 1% probability level ($p = 0.001$). These results render strong support for the hypothesised relationship between the deferral firms' pre-ASRB 1012 long-term foreign debt levels and the subsequent decrease(s) in their foreign long-term debt financing. There is, however, a marginal increase in the absolute levels of long-term foreign debt over the test period.

A potential problem with the interpretation of this regression is that FT86, the proxy for reliance on foreign debt, appears on both the left and right sides of the equation.[22] Hence spurious correlation is possible. Fortunately, because the dependent variables used in regressions 1, 2 and 3 are interdependent (they sum to zero), there is a check against the nature of the correlation.[23]

Given the interdependence, if one correlation is spurious, the second and third regressions should compensate for the effect with similar coefficient significance levels, positively-signed coefficients with magnitudes measured on a pro-rata basis and with similar explanatory power for the regressions. This would occur unless there was some real effect going on instead of, or in addition to, the arithmetic effect from additivity.[24] Since there is a difference in the signs, relative magnitudes and significance of regression 2 and 3 independent variable coefficients and a difference in the explanatory powers of the regressions, something other than chance or spurious effects is affecting the regressions, particularly since two of the three regressions provide strong support for the predictions.

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[22] Since FT86 is deducted from FT88 to form the dependent variable, FT86 is, effectively, on both sides of the regression.

[23] The interdependence means that one of the regressions is redundant However, all are reported because there is theory to support the fitting of each regression to test the hypotheses.

[24] As is necessary with interdependencies of the nature in these regressions, the coefficients sum to zero, regardless of whether there is spurious correlation.

Hypothesis 2 predicts that the increase in the long-term domestic debt levels of deferral firms over the test period is a function of their pre-ASRB 1012 foreign debt reliance. Although the coefficient is in the hypothesised direction, it is insignificant ($p = 0.423$). Further, the direction of the central tendency for the dependent variable in hypothesis 2 is not as hypothesised. Overall, it seems that the deferral firms did not increase their long-term domestic debt levels to compensate for the costly contracting effects of ASRB 1012. This is consistent with their attempting to control their economic and accounting currency risk exposure.

The final regression in Table 6 shows the results of testing whether a relation exists between the levels of the deferral firms' pre-ASRB 1012 foreign debt and the subsequent increase(s) in their share capital and reserves (hypothesis 3). The coefficient is in the hypothesised direction and is significant at the 1% probability level ($p = 0.003$). The regression model explains approximately 30% of the change in the deferral firms' share capital and/or reserves over the test period ($R^2 = 0.304$). In absolute terms, the direction of the means of the changes in share capital and/or reserves lies in the hypothesised direction and, hence, confirms the results of the regression model. Again, this result is consistent with mining companies' attempts to control currency risk exposures.[25]

Summary of Results

Overall, the results support the contracting cost framework. They support hypothesis 1 even though, in absolute terms, there is a marginal increase in foreign long-term debt financing. Evidence indicates that the more foreign debt that the deferral firms had, the greater the contracting costs imposed by ASRB 1012, and the more deferral firms chose to decrease long-term foreign debt finance in order to mitigate the costs.

The difference between deferral and immediate-recognition firms' reductions in domestic currency long-term debt subsequent to ASRB 1012 appears to be insignificant, and the results do not support hypothesis 2. In relative terms, neither the deferral firms nor the immediate-recognition firms increased their domestic debt levels over the sample period. In absolute terms, there is a marginal increase in the long-term domestic debt levels of the immediate recognition firms. This suggests that increasing domestic debt was costly for firms. We predict that this is because of the currency risk exposure it left uncovered.

Hypothesis 3 results are significant and in the hypothesised direction. They indicate that firms increased their levels of share capital and/or reserves to compensate for the reduction in their foreign long-term debt levels.

Conclusions

This study investigates the effect of the immediate recognition requirement of ASRB 1012 on the financing decisions of mining companies engaged in long-term foreign currency transactions. We hypothesised that ASRB 1012 imposed significant contracting costs on firms because of the restriction it placed on the set of accepted accounting procedures and the choice of accounting procedures from within that set.

In summary, the results suggest that mining firms did alter their capital structures in response to ASRB 1012. While a control group *increased* its reliance on foreign currency long-term debt, deferral firms' reliance on long-term foreign debt *decreased* over the test period. Lack of support for the domestic debt hypothesis indicates that increasing domestic debt was not cost-efficient for mining firms seeking to mitigate ASRB 1012's effects. Deferral firms' share capital and/or reserves *increased* over the test period in both relative and absolute terms, while control firms' *decreased*. While the control group was small, its pre-ASRB 1012 financial profile was similar to the experimental group, thus reducing the probability that an omitted variable is driving the results.

Thus, the standard appears to have had a micro-economic effect within the mining sector. In turn, this has potential macro-economic implications if the reactions of mining companies were sufficient to reduce, or at least slow, the rate of growth of Australia's net foreign indebtedness.

A general limitation of this study lies in the restriction of the research issue to the mining industry. Although an intra-industry analysis generates useful information about the accounting and contracting technologies of the particular industry, the results are not generalisable to other settings. Future research in this area could compare the results of this study to a broader analysis of companies in general, or of standards' effects on other industries.

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[25] As an additional measure, we ran regression models for the subsample of immediate recognition firms, recognising that the results must be interpreted cautiously, given the very small sample size of this control group ($n = 7$). For each hypothesis test, the coefficients were less significant than for the deferral firms. The coefficient for the first regression has the hypothesised sign but is significant at only a = 0.100 ($p = 0.080$). Further, the direction of the mean of the dependent variable is not as hypothesised. This suggests that the decreases in the proportion of long-term foreign debt to total long-term finance are not caused by a decrease in the absolute values of the immediate recognition firms' long-term foreign debt financing, but that denominator effects are responsible for the results. In the second regression model, the coefficient is in the predicted direction but is insignificant ($p = 0.448$) and the explanatory power of the independent variable is low ($R^2 = 0.004$). The results for the final regression suggest that immediate recognition firms increased their share capital and/or reserves on the basis of their pre-ASRB 1012 foreign debt levels. The regression coefficient is significant at only the 10% probability level ($p = 0.079$), but has an R^2 of 0.357.

Future research might also sensibly investigate several issues specific to foreign currency accounting regulation. Why, for example, was the immediate recognition requirement really introduced into ASRB 1012? Was it part of an attempt to reduce Australia's level of foreign currency indebtedness? Was it an attempt to fall in line with US requirements? (And if so, why have other standards not followed suit in their requirements?) Was the method perceived to be less open to abuse than deferral methods, or was it perceived to provide better quality information to users? Furthermore, why did mining companies not lobby sufficiently for the requirement to be rejected by standard-setters? What were the costs of lobbying? Given that firms did lobby intensely, what has been the effect of a developing market for synthetic hedges on firms' reactions to the standard?

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The Moment Bound with Unrestricted Random, Cell and Sieve Sampling of Monetary Units

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Abstract—Since its introduction by Dworkin and Grimlund (1984), the moment bound has emerged as a less conservative method of evaluating monetary-unit samples than existing methods for estimating the total error amount in substantive auditing. Arthur Andersen has recently adopted it in place of the Stringer bound (Felix et al., 1990). In this paper we examine its performance with unrestricted random, cell and sieve sampling; the behaviour of the sampling methods is compared by means of an empirical investigation using two new accounting populations. Our results show that the method of sample selection has no effect on the tightness of the moment bound, but does appear to affect the reliability and precision. While the moment bound is reliable in most cases, some reliability problems arise and these are most frequent with unrestricted random sampling. We also observe substantial gains in the precision of the moment bound with cell and sieve sampling in populations with large line items. The reduction in sample size resulting from these gains is demonstrated using the design effect (Kish, 1965).

Introduction

The bounds most commonly used in substantive auditing to estimate the total error amount in accounting populations are the Stringer bound (Stringer, 1963) and the cell bound (Leslie et al., 1979). But numerous studies (see, for example, Neter and Loebbecke, 1975; Reneau, 1978; Plante et al., 1985) have shown that these give overly conservative confidence limits, and hence may incur extra auditing costs by causing unnecessary follow-up investigations for populations with less than material error levels.

To avoid this, Dworkin and Grimlund (1984) developed the moment bound. While the Stringer and cell bounds use the Poisson distribution to obtain an upper confidence limit for the error rate, and combine this with the taints observed in the sample to get an upper bound for the total error amount, the moment bound takes a different approach, using the gamma distribution to obtain an upper confidence limit for the average taint, and combining this with the sample error rate to get the upper bound estimate.

The mathematical development of the moment bound is given in Dworkin and Grimlund (1984), and several studies of its performance have been carried out, including Dworkin and Grimlund (1986), Grimlund and Felix (1987) and Chan and Smieliauskas (1990). None of these studies, however, has examined the effects of the sample selection method on the moment bound. Wurst et al. (1989b) carried out a comparison of unrestricted random, cell and sieve sampling using the Stringer and cell bounds, and found that cell and sieve sampling yield more precise upper bound estimates than unrestricted random sampling when the sample size is not small. This suggests that the moment bound based on cell or sieve sampling may have similar advantages, although we are unaware that any evidence on this point, or on any other aspect of the comparative behaviour of the moment bound with different monetary-unit sample selection methods, has been provided.

In the present study we extend previous empirical work on the moment bound by examining its comparative behaviour with unrestricted random, cell and sieve sampling of monetary units, and by testing its performance using two new accounting populations. We first define the sample selection methods, and then describe the data used in the empirical investigation. An outline of the simulation study design and a discussion of the effects of these three sampling methods on the performance of the moment bound follows. Finally, we discuss the conclusions.

Monetary-unit selection procedures

Monetary-unit sampling involves the selection of a sample of monetary units (e.g. £1) from an accounting population. It is equivalent to 'probability proportional to size' (PPS) selection in survey sampling theory (see Cochran, 1977, pp. 250–255), and is popular among auditors because it gives each line item a probability of selection proportional to its stated monetary amount. Hence, high-valued line items, which have a propensity to large overstatement errors, have a greater chance of being selected than low-valued items.

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Unrestricted Random Sampling

Unrestricted random sampling of monetary units (URS), described in detail in Leslie et al. (1979), is a widely used audit selection procedure. The book value subtotals are cumulated and a set of n random numbers is chosen between one and the total book value amount. The random numbers identify the monetary units, and the line items containing the selected monetary units are audited. With unrestricted random sampling, any line item may be chosen at any selection, and therefore the number of distinct line items in the sample may be less than the nominal sample size. Also, unrestricted random sampling ignores the line item structure of the population when selecting the monetary units; since line items, and not the individual monetary units, are audited, the selected monetary units must be traced back to their associated line items. Wurst et al. (1989b) maintain that this may at times create implementation problems.

Cell Sampling

Cell sampling was developed by Leslie et al. (1979), and is also widely used in practice. A cell sample of n monetary units is obtained by cumulating the book values, dividing the total book amount into n cells (the sampling interval) and selecting a monetary unit independently from each cell. Cell sampling may be viewed as a form of stratified selection where one unit is selected from each stratum (or cell). The process of selection ensures that the sample is distributed evenly across the entire population. Repeated occurrences of monetary units from the same line item do not happen to the same extent as when unrestricted random sampling is used; 'multiple hits', as they are referred to by Leslie et al. (1979), are confined to line items that straddle more than one cell. Like unrestricted random sampling, cell sampling ignores the line item structure of the population when choosing the sample, and the selected monetary units must be traced back to their associated line items.

Sieve Sampling

Sieve sampling was developed for auditing by Rietveld (1978, 1979a, 1979b) in the Netherlands to provide a practical and flexible alternative approach to monetary-unit sampling. It is a special case of Poisson sampling defined by Hájek (1964). Instead of looking at the population as a collection of monetary units from which a sample is drawn, sieve sampling views the population as a collection of line items, each of which has a probability proportional to its recorded value of being selected. Specifically, a sieve sample is selected by first dividing the total book amount by the sample size; this gives the sampling interval. For each line item, a random number is selected independently in the sampling interval and the line item is selected if the random number is less than or equal to the line item size.

Sieve sampling is a form of stratified sampling, where strata of equal size are created and each line item is a subset of one stratum. Sieve sampling exploits the physical composition of the population and it does not require that the selected monetary units be traced back to their associated line items. It has the added advantage that the selected monetary units come from distinct line items. However, the sample size achieved with sieve sampling is not always equal to the nominal n; it may be greater than or less than n depending on the random numbers chosen. It can be shown that, when all the line items are less than or equal to the sampling interval, the achieved sample size is an unbiased estimator of n with a standard deviation less than or equal to $\sqrt{n}$. Hence, when n is not small, the achieved sample size is likely to be relatively close to n.

Test data

To compare the performance of the moment bound with the different sampling methods, two actual accounting populations with contrasting characteristics were utilised; one contained a relatively large number of small accounts (Population 1) and the other a relatively small number of large accounts (Population 2). These were chosen because previous studies have shown that sample selection methods are sensitive to line item size (see for example, Plante et al., 1985). The populations consisted of all positive balances of debtors. Items with zero or negative book values were eliminated on the assumption that if these were not of negligible importance, the auditor would wish to audit them separately. Line items whose book values exceeded the sampling interval, and which were likely to be verified on a 100% basis, were also excluded. This is consistent with current audit practice where 'high value items are aggregated separately. . .and reported separately. They are not projected from the sample onto the population but are added to the statistical projection after the errors in the lower stratum are assessed' (CICA, 1990).

Table 1
Characteristics of Two Accounting Populations

	Population 1	*Population 2*
Total book value amount (Ir£)	2,833,039.0	3,621,349.4
Mean book value (Ir£)	763.4	6,179.8
Standard deviation (Ir£)	1,801.1	8,220.7
Skewness	6.7	1.9
Kurtosis	64.2	2.8
Minimum (Ir£)	2.0	1.0
First quartile (Ir£)	87.0	552.8
Median (Ir£)	239.0	2,535.0
Second quartile (Ir£)	640.0.	6,727.1
Maximum (Ir£)	28,000.0	36,213.0
Number of line items	3711	586

A summary of the characteristics of these populations is given in Table 1. The distributions of the book values are similar to the debtor populations of Neter and Loebbecke (1975) in that they are both positively skewed, and in each case a small proportion of the line items account for a large proportion of the book value total.

A large investigative audit was carried out on each of the two accounting populations to obtain information on error patterns and error amounts. The populations were stratified by book value size, and a disproportionate stratified random sample of size 200 was selected from each population. Stratification was used to investigate error characteristics in line items of differing sizes. The purpose was to obtain sufficient information on error patterns to model the errors in the populations. Line item error rates of 5.5% and 8% were found in the samples drawn from Populations 1 and 2 respectively, and all the errors were overstatements. 44% of the errors in Population 1 and 75% of the errors in Population 2 were 100% overstatement errors. The error patterns are similar to those in Populations 3 and 4 of the Neter and Loebbecke database, which have (i) all overstatement errors, (ii) respective line item error rates of 7.3% and 5.7%, and (iii) 30% and 70% respective incidence of 100% overstatement errors.

The audit results were used to create a set of audit populations with error distributions reflecting the patterns found in the sample data. Five different error rates were used to generate errors into each population; one exactly as found in the investigative audit, two higher and two lower. The lower error rates were one third and two thirds times the observed error rate, and the higher ones were two and three times the sample error rate. Line items that were not 100% in error were seeded with errors using distributions based on the patterns observed in the sample data. In addition, a proportion of 100% taints, corresponding to the proportion found in the investigative audit, were seeded into each population. The taint models and the procedures used to create the audit populations are detailed in the Appendix. A summary of the audit populations' error characteristics is given in Table 2.

With these data, it is possible to study the performance of the moment bound with different error rates in the same population based on the same error pattern. The difference in the level of 100% overstatements in the two populations enables us to investigate its importance with the different sample selection methods; Grimlund and Felix (1987) identified the level of 100% overstatement error tainting to be the most important factor affecting the reliability of the moment bound. They found that a large proportion of coverages tended to fall below the nominal when a high percentage of error amounts (e.g. 20% and 40%) were 100% overstated. Chan and Smieliauskas (1990) obtained similar results in populations with 100% overstatement error incidence of 70%. Also, as noted earlier, populations with different average line item sizes were chosen because empirical evidence has established that the accuracy of the selection methods may be sensitive to line item size.

Comparison of the sampling methods

A rationale for considering different sampling methods can be obtained from classical sampling theory; stratified sampling nearly always results in a smaller variance for the estimated mean or total than a comparable unrestricted random sample, because stratification excludes some extreme sample combinations (Cochran, 1977, p. 99). The greatest gains in precision occur when the strata are internally homogeneous and externally heterogeneous. In accounting populations, therefore, where identical taints associated with the same line item are adjacent, and hence are grouped in the same stratum, a sampling method involving stratification should result in gains in precision.

Table 2
Error Characteristics of the Audit Populations

Population 1		*Population 2*	
Error rate	*Total overstatement amount*	*Error rate*	*Total overstatement amount*
1.8%	Ir£26,230.7	2.7%	Ir£77,798.6
3.6%	Ir£56,233.2	5,4%	Ir£101,917.6
5.5%	Ir£85,814.6	8.0%	Ir£147,593.8
11.0%	Ir£165,496.2	16.00%	Ir£282,668.3
16.5%	Ir£244,498.0	24.00%	Ir£423,523.7

Simulation Study

Samples of sizes 30, 60 and 100 were drawn from each audit population using unrestricted random, cell and sieve sampling of monetary units. These sample sizes were chosen to represent the range of sample sizes currently used in audit practice. For example, in a recent study of auditing procedures in medium-sized accounting firms in England, it was found that samples sizes in the range 25 to 100 were used (Abdul-Hamid, 1993). One thousand replications were performed for each sample size and for each selection method, and the sampling methods were compared in terms of the reliability, tightness and precision of the moment bound at the nominal 95%, 85% and 70% confidence levels. The range of confidence levels were chosen to represent the varying degree of risk accepted in audit practice. McRae (1982, p. 99) deduced that while the choice of a confidence interval is almost invariably a subjective estimate based on the auditor's prior knowledge of the quality of the accounting procedures in the particular audit, a degree of risk somewhere between 30% and 5% seems a reasonable range from which to choose. Wurst et al. (1989b) maintained that confidence levels of 85% and 95% are usually used in audit practice, while Grimlund and Felix (1987) suggested that a confidence level as low as 70% may be used in practice when auditors develop their overall confidence using other sources of information. The results of the simulation study are given in Tables 3 and 4 for Populations 1 and 2 respectively.

Reliability

Reliability is measured by the observed coverage. It represents the proportion of the 1,000 replications in which the value of the bound is greater than, or equal to, the true error amount and is an estimate of the confidence level. A sampling method is said to be reliable if the observed coverage is not more than two standard errors below the nominal. At the 95% confidence level with 1,000 replications, the standard error of the observed coverage is 0.7% and the bound is said to be reliable when it has at least a 93.6% coverage; at the 85% confidence level, the standard error is 1.1%, giving a minimum coverage for reliability of 82.8%; at the 70% confidence level, the standard error is 1.5% and so the minimum coverage for reliability is 67%.

We see from Tables 3 and 4 that the observed coverage reaches the nominal in most cases. Overall, there are 17 incidences of unreliability, nine with unrestricted random sampling, three with cell sampling and five with sieve sampling; so it appears that reliability problems occur most frequently with unrestricted random sampling; this may be due to the fact that cell and sieve sampling are forms of stratified sampling and hence exclude some extreme sample combinations.

Consistent with the results reported in Grimlund and Felix (1987) and Chan and Smieliauskas (1990), the incidence of unreliability increases with the sample size and unreliabilities occur most frequently at lower confidence levels; for example, in Population 2 seven of the 10 unreliabilities occur at the 70% confidence level. The incidence of unreliability is somewhat higher in Population 2 (10 in Population 2 and seven in Population 1) and while all the coverages in Population 1 are within 3% of the nominal, in Population 2 the achieved coverage is sometimes more than 10% lower than the nominal confidence level of 70%. This may be due to the higher incidence of 100% overstatement errors in Population 2, which, as pointed out by many authors, tends to increase the reliability problems of the moment bound.

Tightness

Tightness refers to how much larger the bound is than the population total overstatement error amount. The tightness measure used in this study is the mean of the sampling distribution of the bound for the 1,000 replications expressed in units of the total error amount. If the mean is near the true error amount for a particular sampling method, the sampling method is said to be tight, and if it is substantially greater than the true error amount, the sampling method is said to be con-

Table 3
Performance of the Moment Bound for Population 1

			n=30			*n=60*			*n=100*	
					Performance measures					
Error rate	*Sampling method*	*Cov.*	*Tight*	*Std.*	*Cov.*	*Tight*	*Std.*	*Cov.*	*Tight*	*Std.*
95% Nominal confidence level										
1	URS	100.0	10.44	66.14	100.0	5.80	48.31	100.0	4.06	41.77
	Cell	100.0	10.44	59.42	100.0	5.77	50.39	100.0	4.06	39.30
	Sieve	100.0	10.37	67.40	100.0	5.73	51.40	100.0	4.05	39.69
2	URS	100.0	5.41	104.22	100.0	3.44	75.48	99.9	2.68	59.69
	Cell	100.0	5.26	93.65	100.0	3.40	73.62	100.0	2.67	56.25
	Sieve	100.0	5.36	100.73	100.0	3.42	75.93	99.8	2.66	56.57
3	URS	100.0	4.01	130.98	99.8	2.97	90.43	97.8	2.23	68.76
	Cell	100.0	3.90	122.47	100.0	2.74	87.50	98.2	2.23	65.01
	Sieve	100.0	3.93	125.70	99.9	2.74	94.55	97.9	2.23	68.44
4	URS	99.9	2.70	172.75	96.0	2.09	120.39	94.7	1.81	84.95
	Cell	99.8	2.69	166.02	96.1	2.10	117.48	95.1	1.82	83.43
	Sieve	99.7	2.69	173.18	95.2	2.08	117.99	92.9	1.81	90.67
5	URS	99.2	2.28	196.48	95.4	1.81	134.90	95.5	1.63	96.16
	Cell	98.8	2.23	187.88	95.9	1.84	129.70	96.7	1.62	92.81
	Sieve	98.8	2.23	198.93	95.5	1.83	131.10	95.9	1.62	99.59
85% Nominal confidence level										
1	URS	100.0	6.71	50.36	100.0	3.87	37.77	100.0	2.83	33.30
	Cell	100.0	6.55	44.47	100.0	3.86	39.15	100.0	2.81	31.32
	Sieve	100.0	6.66	51.55	100.0	3.84	40.02	100.0	2.81	31.64
2	URS	100.0	3.70	83.75	99.3	2.47	61.83	92.1	2.02	49.84
	Cell	100.0	3.58	74.56	99.1	2.45	60.12	91.6	2.01	46.88
	Sieve	100.0	3.67	81.14	99.4	2.47	62.10	92.3	2.00	47.13
3	URS	100.0	2.85	107.11	95.8	2.07	75.70	82.5	1.75	58.83
	Cell	100.0	2.76	100.06	95.4	2.06	73.30	82.6	1.74	55.47
	Sieve	100.0	2.79	103.03	95.2	2.05	79.47	82.5	1.74	58.60
4	URS	94.5	2.03	146.64	82.6	1.66	104.75	85.0	1.49	75.43
	Cell	93.3	2.02	140.61	83.6	1.68	102.31	85.9	1.50	74.18
	Sieve	93.9	2.02	147.82	83.6	1.65	102.76	83.5	1.49	80.71
5	URS	88.9	1.78	171.52	84.9	1.50	120.55	84.1	1.39	87.51
	Cell	87.1	1.74	163.80	87.5	1.51	116.11	85.1	1.39	84.64
	Sieve	83.2	1.75	174.56	86.1	1.50	117.41	85.3	1.39	90.89
70% Nominal confidence level										
1	URS	100.0	4.26	39.63	100.0	2.58	30.07	95.4	1.99	26.85
	Cell	100.0	4.13	34.71	100.0	2.58	30.96	95.8	1.92	25.23
	Sieve	100.0	4.23	40.76	100.0	2.56	31.72	95.4	1.97	25.52
2	URS	100.0	2.53	68.06	83.4	1.80	51.11	69.2	1.53	42.02
	Cell	100.0	2.43	60.18	81.6	1.78	49.52	68.9	1.52	39.44
	Sieve	100.0	2.51	66.14	82.2	1.79	51.20	67.6	1.52	39.64
3	URS	97.0	2.03	88.28	73.2	1.57	63.89	75.7	1.38	50.79
	Cell	97.2	1.96	82.43	76.1	1.56	61.88	76.9	1.37	47.77
	Sieve	97.1	1.97	85.10	71.6	1.55	67.33	76.5	1.38	50.63
4	URS	73.6	1.55	125.24	65.8	1.33	91.86	68.6	1.25	67.58
	Cell	74.5	1.54	119.72	67.8	1.35	89.76	71.1	1.26	66.54
	Sieve	72.7	1.54	126.82	66.9	1.33	90.17	67.4	1.25	72.46
5	URS	71.7	1.42	150.44	69.2	1.25	108.48	68.4	1.19	80.24
	Cell	71.1	1.38	143.44	72.9	1.27	104.65	70.8	1.20	77.75
	sieve	69.5	1.39	153.75	72.8	1.26	105.85	67.9	1.20	83.56

servative. Clearly, from Tables 3 and 4, the tightness of the moment bound does not appear to be affected by the method of sample selection. For any given sample size and confidence level, the tightness is similar with the three sampling methods; the similarity prevails for populations with different book value characteristics and with different error rates. A noteworthy aspect of the tightness results is that the moment bound is extremely conservative for samples of size 30,

Table 4
Performance of the Moment Bound for Population 2

		n=30			n=60 Performance measures			n=100		
Error rate	*Sampling method*	*Cov.*	*Tight*	*Std.*	*Cov.*	*Tight*	*Std.*	*Cov.*	*Tight*	*Std.*
95% Nominal confidence level										
1	URS	100.0	5.41	131.79	100.0	3.60	106.74	97.5	2.81	90.56
	Cell	100.0	5.41	119.39	100.0	3.51	98.32	98.9	2.81	73.67
	Sieve	100.0	5.46	118.21	100.0	3.53	91.48	99.2	2.79	63.25
2	URS	100.0	4.40	146.92	99.0	3.14	123.36	98.8	2.53	100.20
	Cell	100.0	4.46	144.91	98.2	3.07	116.83	99.2	2.56	84.34
	Sieve	100.0	4.45	142.31	98.6	3.08	109.97	99.7	2.52	74.01
3	URS	100.0	3.41	184.42	99.1	2.67	142.88	92.7	2.25	110.98
	Cell	100.0	3.46	181.52	98.9	2.59	135.34	95.6	2.23	95.28
	Sieve	100.0	3.45	183.59	99.3	2.61	132.67	96.5	2.22	88.12
4	URS	99.1	2.46	261.64	96.2	2.11	173.60	95.3	1.85	130.43
	Cell	98.9	2.55	245.14	97.1	2.10	163.62	98.6	1.86	108.54
	Sieve	99.0	2.50	263.23	97.0	2.09	160.92	98.9	1.85	101.98
5	URS	95.9	2.11	290.51	97.5	1.85	189.41	97.6	1.66	140.10
	Cell	97.3	2.16	284.84	98.6	1.85	179.12	99.2	1.67	118.65
	Sieve	96.3	2.10	301.18	98.0	1.84	180.57	99.6	1.66	119.30
85% Nominal confidence level										
1	URS	100.0	3.52	108.69	98.0	2.46	87.89	86.8	2.00	75.17
	Cell	100.0	3.52	98.91	97.0	2.40	80.26	93.7	2.01	60.79
	Sieve	100.0	3.56	97.79	97.5	2.41	74.37	97.2	1.99	51.91
2	URS	100.0	2.92	121.86	98.8	2.22	102.64	77.4	1.86	84.43
	Cell	100.0	2.97	120.50	98.0	2.16	96.54	82.7	1.95	70.70
	Sieve	100.0	2.96	117.97	98.6	2.16	90.75	86.4	1.85	62.00
3	URS	97.7	2.35	153.05	92.3	1.91	120.58	90.4	1.72	95.89
	Cell	98.4	2.39	150.81	92.8	1.89	113.61	93.0	1.70	81.94
	Sieve	98.2	2.38	153.11	93.6	1.91	111.67	95.2	1.69	75.90
4	URS	90.9	1.81	224.33	88.1	1.64	153.17	89.7	1.50	117.19
	Cell	93.3	1.88	209.65	89.0	1.63	143.90	94.4	1.50	97.96
	Sieve	91.2	1.84	226.60	88.6	1.63	141.37	95.4	1.50	92.00
5	URS	86.3	1.61	255.44	87.6	1.50	171.85	90.5	1.40	129.32
	Cell	88.5	1.67	251.10	89.1	1.50	162.38	94.8	1.40	109.62
	Sieve	86.0	1.61	265.97	90.3	1.49	164.13	93.3	1.39	110.46
70% Nominal confidence level										
1	URS	96.9	2.28	89.02	75.1	1.70	72.20	62.8	1.46	62.61
	Cell	97.8	2.28	81.15	76.6	1.65	65.46	68.4	1.45	50.31
	Sieve	97.9	2.31	80.06	80.1	1.65	60.39	72.5	1.43	42.77
2	URS	97.7	1.94	100.31	56.3	1.57	85.29	77.2	1.39	71.42
	Cell	98.3	1.97	99.24	56.7	1.53	79.79	82.4	1.40	59.53
	Sieve	98.0	1.96	96.91	58.1	1.53	74.87	86.2	1.39	52.24
3	URS	69.1	1.62	126.58	72.3	1.45	102.03	75.1	1.34	83.27
	Cell	71.6	1.65	124.76	70.4	1.40	95.66	78.5	1.32	70.87
	Sieve	70.3	1.65	127.06	72.9	1.41	94.22	79.9	1.31	65.79
4	URS	66.2	1.34	192.01	72.2	1.30	135.54	69.6	1.23	105.86
	Cell	73.9	1.40	179.02	71.9	1.29	127.00	72.3	1.23	88.82
	Sieve	68.6	1.37	194.61	72.7	1.28	124.61	73.5	1.23	83.50
5	URS	66.4	1.26	224.44	73.2	1.23	156.31	75.3	1.19	119.86
	Cell	70.7	1.30	221.19	73.1	1.23	147.59	77.1	1.19	101.67
	Sieve	63.4	1.25	234.62	71.3	1.23	149.54	76.1	1.19	102.65

particularly in low error rate populations; it becomes less so as the sample size increases. The tightness also improves as the confidence level decreases.

Precision

For any given tightness, a more precise boun is preferred for helping to distinguish betwee acceptable and unacceptable total error amounts

Table 5
Design Effects in Population 1 at the 95% Confidence Level

		n=30		*n=60*		*n=100*	
Error rate	*Sampling method*	*Design effect*	*Sample size*	*Design effect*	*Sample size*	*Design effect*	*Sample size*
1	Cell	0.81	24	1.08	65	0.89	89
	Sieve	1.04	31	1.13	70	0.90	90
2	Cell	0.81	24	0.95	57	0.89	89
	Sieve	0.93	28	1.01	67	0.90	90
3	Cell	0.87	26	0.94	56	0.89	89
	Sieve	0.92	28	1.09	66	0.99	99
4	Cell	0.92	28	0.95	57	0.97	97
	Sieve	1.01	30	0.96	58	1.14	114
5	Cell	0.91	27	0.92	56	0.93	93
	Sieve	1.03	31	0.94	57	1.07	107

provided, of course, that the bound is reliable. If the standard deviation of the bound's sampling distribution is small for a particular sampling method, the sampling method is said to be precise, and if it is large, the sampling method is said to be imprecise. The results in Tables 3 and 4 show that while the selection methods do not appear to have any important effect on the tightness of the moment bound, they do tend to affect the variability of its sampling distribution, particularly in populations with large line items where substantial gains in the precision of the moment bound with cell and sieve sampling occur. Specifically, in small line item populations (Table 3), cell sampling is somewhat more precise than unrestricted random and sieve sampling in most cases. In large line item populations (Table 4), the moment bound with cell sampling is more precise than with unrestricted random sampling in all cases, and with sieve sampling, it is more precise than with unrestricted random sampling in most cases; the greatest gains in precision for cell and sieve sampling occur with large sample sizes. Also, in large line item populations, sieve sampling is somewhat more precise than cell sampling in most cases with samples of sizes 60 and 100. For samples of size 30, cell sampling is more precise than sieve sampling in the high error rate populations. The results for cell sampling are consistent with the findings of Plante et al. (1985), that the cell, Stringer and multinomial bounds are more precise with cell sampling than with unrestricted random sampling in populations with large line items. The improvement in precision of cell and sieve sampling over unrestricted random sampling is not unexpected since, as noted earlier, these selection methods are forms of stratified sampling and therefore exclude some extreme sample combinations.

Design Effect

Since the sampling methods appear to differ with respect to the precision of the moment bound, the extent of the difference and the effect it has on sample size planning can be measured by the design effect (Kish, 1965 p. 258). This is defined as the ratio of the actual variance of the moment bound with a particular sampling method compared to the variance of the bound with unrestricted random sampling. In sample size planning, the design effect (deff) may be interpreted as the proportion increase or decrease in the sample size, using the particular sampling method to obtain the same precision as unrestricted random sampling. For example, if it is estimated that the design effect of cell sampling is 0.8 with a sample of size $n = 60$, then a sample of size $n = 48$ (i.e. $60 \cdot 0.8$) with cell sampling will give the same precision as unrestricted random sampling. Similarly, if the design effect is 1.2 based on a sample of size $n = 60$, then a sample of size $n = 72$ (i.e. $60 \cdot 1.2$) is needed to obtain the same precision as unrestricted random sampling. The design effects of cell and sieve sampling at the 95% confidence level, together with the sample size necessary to obtain the same precision as unrestricted random sampling with samples of sizes 30, 60 and 100, are given in Tables 5 and 6. The design effects at the 85% and 70% confidence levels are similar and are not presented here.

The results in Tables 5 and 6 provide further evidence that cell and sieve sampling favour populations with large line items; they lead to substantial reductions in the nominal sample size of unrestricted random sampling, especially for large sample sizes. These conclusions are no different from the precision results presented in Tables 3 and 4; they simply provide another perspective.

Table 6
Design Effects in Population 2 at the 95% Confidence Level

		$n=30$		$n=60$		$n=100$	
Error rate	*Sampling method*	*Design effect*	*Sample size*	*Design effect*	*Sample size*	*Design effect*	*Sample size*
1	Cell	0.82	25	0.85	51	0.66	66
	Sieve	0.80	24	0.73	44	0.49	49
2	Cell	0.97	29	0.90	54	0.71	71
	Sieve	0.94	28	0.80	48	0.55	55
3	Cell	0.97	29	0.90	54	0.74	74
	Sieve	0.99	30	0.86	51	0.63	63
4	Cell	0.88	26	0.89	53	0.69	69
	Sieve	1.01	30	0.86	52	0.61	61
5	Cell	0.96	29	0.89	54	0.72	72
	Sieve	1.07	32	0.91	55	0.73	73

Presenting results in this manner is more enlightening than a mere assertion that the precision differs. Finally, it should also be pointed out that a decrease in the sample size will reduce the bound's tightness, and this must be considered when deciding on the sample size based on the design effect. However, since the greatest reduction in sample size occurs with the samples of nominal size 100, the impact on tightness will not be as great as if the reductions were made at the lower sample sizes.

Conclusions

This study examined the comparative performance of the moment bound for estimating the total error amount using unrestricted random, cell and sieve sampling. The investigation was carried out by means of a simulation study, using two actual accounting populations with a range of error rates and error amounts that may occur in real audit environments.

The moment bound was reliable in most cases; some incidences of unreliability occurred, and these were most frequent with unrestricted random sampling and with low confidence levels. No substantial differences were found in the sampling methods with respect to the tightness of the bound. Gains in precision occurred with cell and sieve sampling, especially in populations with large line items where the improvement in precision over unrestricted random sampling was substantial with large samples.

In general, if the reliability and tightness of the sampling methods are the same, the auditor should use the selection method that has the highest precision. Based on the empirical evidence, the choice for the auditor is between cell and sieve sampling; but the performance of neither method uniformly dominates the other. Consequently, the decision must be made on non-statistical grounds. If the auditor considers it more convenient to use the line item structure of the population when selecting the monetary units, then sieve sampling is preferred. On the other hand, if the auditor finds that the variable sample size of sieve sampling may cause problems when attempting to estimate the cost of the audit, then cell sampling is preferred.

Appendix

Taint Models

In Population 1, a regression model was fitted to the taints using the corresponding book value as the independent variable. Line items that were not in error and items with 100% taints were not included in the taint modelling. The purpose of the regression analysis was to predict the taint value other than 0 or 1. To improve the fit, it was necessary to transform both the independent and dependent variables. The sample data were used to obtain estimates of the coefficients using least

Table 7
Regression of Taint on Book Value in Population 1

Predictor	*Coeff.*	*Std.*	*t-ratio*	*p*
Constant	0.08	0.04	2.49	0.04
1/book value	219.69	42.38	5.18	0.00
	$s=0.0767$		$r^2(\text{adj})=0.764$	

squares regression, and the regression equation was found to be

Table 7 gives the details of the regression analysis.

The r^2 of 0.764 indicates that the model is able to take account of 76.4% of the total variation in the dependent variable. Examination of the residuals showed that heteroscedasticity was not present.

It was not possible to model the taints from the sample data in Population 2 because the observed number of non-zero taints less than 1 was too small. Therefore, a theoretical distribution was used to generate the taint values. While empirical evidence indicates that no single assumption about the shape of the taint distribution is appropriate in all audit situations, many studies have shown that most error taints follow a reversed J-shaped distribution with a mass at 1, and the non-zero taints, which are less than 1, may be modelled using an exponential distribution truncated at 1 (e.g. Wurst et aL, 1989a; Leitch et al., 1982; Peek et al., 1991). In this study, taints were generated using the exponential distribution with the parameter set at the sample mean of the non-zero taints.

Creation of the Study Populations

1. Population 1 was divided into three strata. The division points were Ir£500 and Ir£5,000. Population 2 was divided into two strata with division point Ir£5,000. These division points placed the majority of the line items in the lowest stratum.
2. A proportion of line items corresponding to the lowest error rate was selected at random from each stratum.
3. From the selected line items, the number that were 100% in error were allocated randomly. In Population 1, all the errors in the first stratum and 44.4% in the second stratum were 100% overstatement errors; there were no 100% overstatement errors in the third stratum. In Population 2, 90% in the first stratum, and 66.6% of the errors in the second stratum, were 100% in error.
4. The remainder of the selected line items were allocated a taint value according to the taint distributions described above.

For each of the other error rates, an appropriate number of extra line items were selected randomly and steps (3) to (4) were repeated.

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The Simultaneous Relation Between Auditor Switching and Audit Opinion: An Empirical Analysis

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Abstract—Previous studies examining the relation between the audit opinion and auditor switching assume a one-way causation, with the issuance of a qualified opinion triggering a switch. However, analytical studies dealing with auditor independence issues (e.g., Magee and Tseng, 1990; Dye, 1991; Teoh, 1992) suggest an opposite causation, in which the auditor is *less* likely to qualify the opinion for a client who may switch auditors. Some evidence of an opposite causation is provided by Krishnan (1994), who finds that auditors treat switchers more conservatively (relative to non-switchers) in issuing the audit opinion. The causation between switching and the audit opinion is clearly important for policy decisions regarding both opinion shopping and auditor independence. In this paper, we test the two-way causation hypothesis and find evidence in support of a two-way causation. Our simultaneity-adjusted estimates confirm previous findings of a positive effect of a qualified opinion on switching (Chow and Rice, 1982; Craswell, 1988; Citron and Taffler, 1992). However, we find in addition that auditors are *more* likely to issue qualified opinions to switchers. This finding does not support the analytical studies cited earlier.

Introduction

In this study, we test the hypothesis that a two-way causation exists between the auditor's issuance of a qualified (modified) opinion and the client's propensity to switch auditors.[1] The relation between auditor switching and the audit opinion has been the focus of both policy-makers' and academicians' attention in recent years. Most previous work has focused on the effect of the prior-year opinion on switch. The evidence is mixed. While Chow and Rice (1982), Craswell (1988) and Citron and Taffler (1992) find a significant positive relationship between a qualified opinion and subsequent auditor switching, others (e.g., Schwartz and Menon, 1985; Haskins and Williams, 1990) report no significant relation between the two variables.

All of this work tests the argument that a qualified opinion triggers a switch by the client, so that the opinion is the independent variable and the subsequent switch the dependent variable. However, several analytical studies (e.g., Magee and Tseng, 1990; Dye, 1991; Teoh, 1992) argue that the possibility of a switch by a client can influence the auditor's opinion, suggesting a causation opposite to that analysed in the empirical work cited above. DeAngelo (1982, p. 185) argues that the causation may run in *both* directions, i.e., 'qualified opinions can cause auditor changes, or auditor changes can cause qualified opinions'. Some evidence of an opposite causation is provided by Krishnan (1994, p. 207), who finds that auditors treat switching clients more conservatively (relative to non-switching clients) in issuing the audit opinion.

Unlike the focus in previous work on a one-way causation, we model the relation between the audit opinion and auditor switch as a two-way (or *simultaneous*) relation, with the audit opinion influencing the switching, and with switching influencing the audit opinion decision. If such simultaneity exists, estimation of the one-way relation would not yield consistent estimates. Also, such simultaneity can explain why the empirical evidence has not resulted in uniform findings. Using ex post data on auditor switching as a proxy for the client's ex ante

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[1] SAS No. 58 (AICPA, 1988) has changed the way in which a qualified opinion is reported. Prior to the issuance of SAS No. 58, auditors issued 'qualified' opinions for material uncertainties such as those relating to recoverability of an asset's book value or a company's ability to continue as a going concern. Under SAS No. 58, auditors issue unqualified opinions with modifications, or 'modified' opinions for material uncertainties. We use the term 'qualified' opinions in its pre-SAS 58 sense, to refer to all opinions relating to material uncertainties.

propensity to switch auditors, we estimate a simultaneous equations model of audit opinion and switching to separate the two effects.

The issue is relevant to policy-makers, since the current emphasis in the empirical literature on the impact of opinion on switching has caused considerable discussion about opinion shopping.[2] In the US, the Securities and Exchange Commission (SEC) has introduced an increasing number of policy measures in recent years to control possible opinion shopping (e.g., SEC, 1985, 1987, 1988, 1989). Also, the suggestion in the analytical literature that switching may influence the issuance of a qualified opinion raises concerns about auditor independence and objectivity.

In the empirical analysis, we first estimate switching and qualification equations under the assumption of no simultaneity. We find that a qualified opinion has a significant positive effect on switching, a finding reported in Chow and Rice (1982), Craswell (1988) and Citron and Taffler (1992). Also, inclusion of switching in a qualifications model yields a significant positive sign. Next, we estimate switching and qualification equations using a simultaneous equations approach. The results provide support for the presence of a simultaneous relation. In particular, we find that, after controlling for simultaneity, the issuance of a qualified opinion continues to have a significant effect on the probability that the client will switch auditors. In addition, the probability of a switch has a significant positive effect on the probability that the auditor will issue a qualified opinion. These findings provide one possible explanation for the inconclusive evidence on the effect of qualified opinion on subsequent switch, since previous studies do not consider the two-way causation between the two variables.

Motivation

The Effect of Opinion on Switching

Chow and Rice (1982) examine the influence of qualified opinions on auditor switches. Using a logit model with switching status as the dichotomous dependent variable, and qualification as one of the independent variables (with controls for some other reasons for switch), they find that the receipt of a qualified opinion has a significant positive impact on a company's propensity to switch auditors (p. 330). Similarly, Craswell (1988, p. 27), and Citron and Taffler (1992, p. 343) find a significant positive relationship between issuance of a qualified opinion and subsequent auditor switching. In a related study, Johnson and Lys (1990, p. 295) find that clients who move from larger to smaller auditors are more likely to do so following a qualified opinion or disagreement with the incumbent auditor, than those who switch from smaller to larger auditors. On the other hand, DeAngelo (1982, p. 185) rejects the hypothesis that qualification avoidance is an important motivation for changing auditors in a sample of companies in the petroleum industry. Similarly, Schwartz and Menon (1985, p. 256) and Haskins and Williams (1990, p. 69) do not find a significant relation between switching and qualified opinion.

The Effect of Switching on Opinion

DeAngelo (1982, p. 185) points out that the qualification's treatment as an exogenous variable in switching studies may not be correct. The idea that switching may have an impact on the audit opinion decision is also implicit in analytical analyses of the qualification decision. Teoh (1992) examines the qualification decision of the auditor faced with the possibility that the client will change auditors if a qualified opinion is issued. Teoh considers two types of auditors: mechanical and strategic. A mechanical auditor assesses the client's situation and issues an opinion, without considering the possibility of a switch by the client. However, the strategic auditor engages in a cost-benefit analysis, specifically balancing the costs of the loss of the client (if a switch follows the issuance of opinion) against the costs of litigation associated with an incorrect opinion. The client, on the other hand, is postulated to switch after a qualified opinion if costs are sufficiently low, or if firm value is sufficiently high. Clearly, such a formulation suggests simultaneity between the switching and qualification decisions: causation may run in either or both directions.

Dye (1991) examines more directly the interaction between a client's decision to replace the auditor and the auditor's decision to audit the client. Dye's analysis focuses on the earnings the company reports and the auditor's decision on whether to attest to the number claimed by management or to a different number. Dye argues that 'an auditor is more likely to be replaced the more favourable is the client's perceptions of the firm's [client's] financial condition relative to the auditor and the lower the report [earnings] the auditor is willing to attest to, and will *not* be replaced when the client knows no more about its financial condition than its auditor and the financial reports reveal all this information' (pp. 362–363). Again, this implies that the auditor's incentives to attest to a given report are closely linked to the likelihood of the client's decision to switch.

Magee and Tseng (1990) develop a multi-period model to examine the circumstances under which auditors have incentives to compromise their independence. Of particular interest to this study is their finding that, with many other conditions, one necessary condition for a reduction in independence is that the client must benefit from the 'preferred reporting strategy' even after an auditor switch (p. 330). Once again, this establishes a link between the decisions to issue an audit opinion and to switch. Note that these arguments imply simultaneity between the opinion and switch even if different parties make the decisions. The simultaneity arises because the arguments that enter each decision function are affected by both parties.

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[2] Opinion shopping refers to 'the search for an auditor willing to support a proposed accounting treatment designed to help a company achieve its reporting objectives even though that treatment might frustrate reliable reporting' (SEC, 1988).

While all these analytical studies suggest that a switch could have a negative effect on the qualification probability, there is some empirical evidence that, in fact, auditors treat switchers more *conservatively* in their reporting decision. Krishnan (1994) estimates a qualification model, the results for which reveal that auditors treat switchers more conservatively (than non-switchers) in the opinion decision, after controlling for differences in clients' financial conditions. Krishnan conjectures that a client's switching status might proxy for private information obtained by the auditor that leads the latter to a conservative treatment of the client.

Other aspects of the audit market provide alternative explanations of switchers' conservative treatment. A switch by the client usually brings with it increased scrutiny by the SEC. In addition to specifying disclosure requirements for clients, SEC Practice Rules also require (since 1989) notification of the SEC by the auditor of a change in an audit relationship, even if the registrant fails to report such a change (Public Accounting Report, 1992). Scrutiny can also be expected from the new auditor, who may request access to working papers, and from analysts and investors investigating the reasons for the auditor change. The likelihood of lawsuits and professional damage, and therefore the expected business risk, can increase because of such actions. An auditor's natural response to the increase in business risk could be in the direction of increased caution, perhaps through adopting stricter interpretations of Generally Accepted Accounting Principles (GAAP) and/or Generally Accepted Auditing Standards (GAAS).

Simultaneity

The possibility of a joint causal relation between the audit opinion and auditor switch implies that models treating the qualification as an exogenous explanatory variable may distort the relation. The opinion-shopping argument suggests that a qualified opinion has a *positive* effect on the probability of a switch. As for the effect of switching on qualification, the analytical work cited above suggests that switching has a *negative* effect on the issuance of a qualified opinion, since the possibility of a switch is expected to make the auditor reluctant to issue a qualified opinion. However, if a switch by a client makes the auditor conservative, we might expect a positive effect of switching on the issuance of a qualified opinion.

Empirical approach

In this section, we outline an audit opinion and auditor switching simultaneous equations model. Let S* and Q* denote unobserved latent variables that represent the propensity of the client to switch auditors and that of the auditor to issue a qualified opinion, respectively. If switching is motivated by the issuance of a qualified opinion, the propensity of a client to switch auditors, S*, is a function of Q*. In addition, S* can be written as a function of a vector of observed characteristics, X_1 and an error term, μ_1:

$$S^* = \gamma_1 Q^* + X_1\beta_1 + \mu_1 \qquad (1)$$

Previous work has specified the auditors' propensity to issue a qualified opinion as a function of observed and unobserved characteristics X_2 and μ_2 respectively. If a simultaneous relation between switching and the audit opinion exists, then Q* depends on S* as well. Thus,

$$Q^* = \gamma_2 S^* + X_2\beta_2 + \mu_2 \qquad (2)$$

We assume that the error terms, μ_1 and μ_2, have normal distributions each with zero mean and unit variance.

Because both S* and Q* are unobserved, equations (1) and (2) cannot be estimated directly. What we observe are the company's actual qualification and switching status. Following previous work, we use the actual qualification (QUAL, coded 1 for a qualified opinion, zero otherwise) as a proxy for the propensity to issue a qualified opinion (Schwartz and Menon, 1985). Similarly, the actual switch (SWITCH, coded 1, if the client is audited by a different auditor in the following fiscal year, zero otherwise) is used as a proxy for the client's propensity to switch (Citron and Taffler, 1992). One problem with this formulation is that the SWITCH variable, which reflects the ex post event of a change in auditors, is a proxy for the auditor's ex ante perception that the client may switch auditors.[3] The variable's validity depends on whether one can reasonably assume that the auditor is aware of the client's intentions at the time of issuing the report.[4]

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[3] We are grateful to the associate editor, Peter Moizer, and an anonymous referee for pointing out this deficiency in the SWITCH variable.

The process of auditing a client involves considerable exchange of information, which provides avenues for the auditor to make judgments about the client's expectations and the likelihood that the client will seek to change auditors. Previous work has pointed out that before the opinion is issued, the auditor and client go through several iterations of acceptable outcomes (Antle and Nalebuff, 1991; Teoh, 1992). At the time of issuing the opinion, therefore, the auditor is likely to have a fairly accurate perception of a possible switch by the client. To the extent that auditor change occurs fairly soon after the report has been issued, it seems reasonable to argue that the observed (ex post) behaviour of most clients reflects their ex ante intentions.[5] The rest of this paper is based on the premise that the variable SWITCH is a reasonable approximation of the auditor's ex ante expectation about the client's switching propensity.

Probit estimates of equations (1) and (2) do not yield consistent estimates of the coefficients because of the simultaneity between S* and Q*. To obtain these, we estimate the equations using a two-stage procedure (Maddala, 1983, p. 246). In the first stage, we obtain reduced form estimates, where the reduced form equations are given by:

$$S^* = X\,\Pi_1 + \nu_1 \tag{3}$$

$$Q^* = X\,\Pi_2 + \nu_2 \tag{4}$$

The vector X includes all variables in X_1 and X_2. We then substitute the predicted values of S* and Q*, $\hat{S}^*$ and $\hat{Q}^*$, in equations (1) and (2), and estimate the following (structural) equations using probit maximum likelihood.

$$S^* = \gamma_1\,\hat{Q}^* + X_1\beta_1 + \mu_1 \tag{5}$$

$$Q^* = \gamma_2\,\hat{S}^* + X_2\beta_2 + \mu_2 \tag{6}$$

We compute the asymptotic covariance matrix of the estimates following Maddala (1983, pp. 246–247).[6]

Simultaneity: Hypothesis Testing

The standard approach of including the audit opinion as an independent variable in a switching equation assumes that the opinion is *exogenous* to switching or that there is no *simultaneity* between switching and the audit opinion. A test for exogeneity or simultaneity is the test of the null hypothesis $\gamma_2 = 0$. The alternative hypothesis suggested by the analytical studies is $\gamma_2 < 0$.

Data

The empirical model is estimated for a sample of publicly-traded US companies, taken from the September 1988 version of the Disclosure Inc. database. Our initial sample consisted of all non-financial companies on that database.[7] We then imposed the following selection criteria to reach the final sample:

1. Availability of price information on the CRSP data tapes, for at least 70 days before the fiscal year end.
2. Verifiability of the switching status and the qualification from at least one other source, such as Compustat, *Who Audits America*, 10–K and 8–K filings, and annual reports.
3. Availability of valid information for all variables used.

The final sample has 1,878 observations. Fiscal year ends for our sample of companies range over three years, 1986 through 1988.

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[4] Yet another shortcoming of the assumption that actual switches reflect the 'threat' of a switch was pointed out by an anonymous referee. A threat of a switch could have two possible outcomes. First, the auditor could qualify the report despite the threat, and the client could subsequently switch. Our model would capture such situations. Second, a threatened switch may be followed by the issuance of a clean opinion, whereupon the client decides not to switch. Such situations cannot be captured by our model.

[5] There is some empirical evidence that, on average, auditor changes occur within a few months of the report being issued. For example, Schwartz and Soo (1995) report that the average time period for the appointment of a new auditor is 128 days prior to the next fiscal year-end. Also, the average time period between fiscal year-ends and the audit report being issued is 60 days. It is reasonable to conclude that the change in auditors occurs, on average, 177 days (365–128–60) or about six months after the report has been issued by the predecessor auditor. Given that some lag is likely to occur because the client must (a) engage in a search for the new auditor, and (b) comply with SAS No. 7 (AICPA, 1975) that requires successor auditors to communicate with the predecessor auditors before accepting an engagement, we expect the SWITCH variable to capture clients' ex ante intentions at the time of the audit report being issued.

[6] For an application of the simultaneous model approach in a different context, see Stern (1989).

[7] As noted by Dopuch et al. (1987, p. 434), the financial variables used in qualification studies may be inappropriate for companies in the financial service industry. Ohlson (1980, p. 114) expressed similar reasons in his study of bankruptcy for excluding these companies.

The two dependent variables are QUAL and SWITCH. QUAL is coded one for qualified opinions (litigation, asset realisation, going concern and multiple qualifications) and zero otherwise. Thus the zero category includes unqualified opinions and consistency exceptions. About 10.9% of the sample received a qualified opinion. The qualified opinions include 44.39% of litigation and asset realisation qualifications, and 55.61% of going concern opinions. The SWITCH variable represents the company's switching status, and is coded one if the company changed auditors in the *following* year, zero otherwise. The switching rate in the sample is 6.2%.

Model specification

The Switching Equation

The switching equation includes the qualification variable (QUAL) and a vector of characteristics X_1 to control for other factors that affect the switching decision. A vast literature exists on other switching determinants (see, for example, Bedingfield and Loeb, 1974; Francis and Wilson, 1988; Johnson and Lys, 1990; Haskins and Williams, 1990; DeFond, 1992; Krishnan, 1994; Lindahl, 1994). Following Lindahl (1994), we classify the variables used in previous literature into four categories: financial distress, services, auditor characteristics, and other factors.

Previous studies (e.g., Schwartz and Menon, 1985) have suggested that financially distressed companies may be more likely than healthy companies to change auditors. The motivation for such a change could be a need for different services, an inability to pay audit fees or disagreements with the incumbent auditor over accounting policies or disclosures. We construct a summary measure of financial distress (DISTRESS), using a model from Zmijewski (1984, Table 3). The particular model we use is $\text{DISTRESS} \doteq F(X)$ where $X = -4.803 - 3.599*\text{ROA} + 5.406*\text{FINL} - 0.1*\text{LIQ}$ ($\text{ROA} =$ Net Income/Total Assets, $\text{FINL} =$ Total Debt/Total Assets, $\text{LIQ} =$ Current Assets/Current Liabilities), and $F(.)$ is the cumulative distribution of the standard normal variable. Higher values of this variable suggest greater financial distress; we therefore predict a positive sign for this variable.

The need for different services has been identified in the literature (e.g., Carpenter and Strawser, 1971; Francis and Wilson, 1988; Johnson and Lys, 1990; DeFond, 1992) as a reason for auditor changes. Two factors that could require a change are the decision to issue new securities and the expectation of high growth in the future. We identified companies in our sample that issued new securities in the near past or expressed an intention to issue new securities in the near future, and constructed a dummy variable PUBOFFER. To identify high-growth companies, we examined the growth rate of assets for our sample companies in the year following the year of analysis. We classified all companies with growth rates in the top quartile of our sample as high growth companies.[8] A dummy variable (GROWTH) is coded one for high growth companies, zero otherwise.

Two variables, INDSHARE and BIG6 represent auditor-related factors. INDSHARE is the auditor's share in the client's industry.[9] The auditor's industry share can reflect audit expertise and can also proxy for reputation effects (Ettredge and Greenberg, 1990). We expect that a client is less likely to switch from an auditor with a high share in its industry.[10] The BIG6 variable takes the value one for a Big Six auditor, zero otherwise. Previous studies have used this variable to represent both audit quality and auditor reputation. We therefore expect a negative sign for this variable.

Finally, two variables, ACQUISITION and SIZE, represent other factors. Previous studies (e.g., Burton and Roberts, 1967) have found mergers and acquisitions to be associated with auditor changes. We examined stock acquisitions for our sample companies over a 24-month period (from 18 months prior to, up to six months following, the year-end).[11] A dummy variable, ACQUISITION, is coded one if there was a change in ownership of at least 50% over this period, zero otherwise. Previous work has identified client size (e.g., Haskins and Williams, 1990; Krishnan, 1994; Lindahl, 1994) in explaining auditor changes. We use the natural logarithm of assets as our size variable.

The Qualification Equation

The qualification equation includes the SWITCH variable and a vector of characteristics X_2. A number of studies (e.g., Mutchler, 1985; Dopuch et al., 1987; Koh and Killough, 1990; Bell and Tabor, 1991) have conducted detailed analyses of the role of financial and market variables that enter X_2. Because the focus of this study is on the possible simultaneity between the audit opinion and switching, we base our choice of independent variables included in the X_2 vector on Dopuch et

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[8] The third quartile for the distribution of growth rates in our sample is about 21%. We also checked for sensitivity of this specification by using other cut-offs to define high growth. Our results remained unaltered.

[9] We constructed this variable using the September 1988 Disclosure Inc. database. We treated all valid observations as our population.

[10] However, as an anonymous referee points out, there may be a threshold for the effect of industry share. Proprietary interest type of concerns may prevent clients from retaining auditors that also audit competing companies in the same industry. For example, following the merger of Arthur Young and Ernst & Whinney, the newly created audit firm of Ernst & Young had to choose between Pepsico (a client of Arthur Young) and Coca Cola (a client of Ernst & Whinney).

[11] We searched *Mergers and Acquisitions* for this information.

Table 1
The Audit Opinion and Auditor Switching

	Qualification Type		
Switching status	*Qualified*	*Unqualified*	*Total*
Switchers	27 [23.28%] (13.17%)	89 [76.72%] (5.32%)	116 [100%]
Non-switchers	178 [10.10%] (86.83%)	1,584 [89.9%] (94.68%)	1,762 [100%]
Total	205 (100%)	1,673 (100%)	1,878

Chi-square (p-value) = 19.423 (0.000)

Note: Numbers within parentheses are the column percentages. Numbers within brackets are the row percentages.

al. (1987).[12] Ratios of receivables (REC/ASSET) and inventories to assets (INV/ASSET) capture high-risk accounts. The liabilities/assets (LIAB/ASSET) ratio measures leverage. Firm size (SIZE, measured by the logarithm of assets) and a dummy for operating losses (LOSS) proxy for possible financial distress.

The X vector includes three market variables. Beta (BETA) and residual standard deviation of returns (SDRET) from the market model measure systematic and firm-specific risks respectively. Returns minus market return (RET-MRET) measures the firm's performance relative to the market. To control for industry-related differences in performance, the model includes six industry dummies: agriculture, forestry, fishing and mining (AGRIMIN), construction (CONSTR), manufacturing (MANUF), transportation and utilities (TRANSP), wholesale (WHOL), and retail (RETAIL). We also include a control for the time listed on an exchange (TIME).

Empirical results

Table 1 presents the breakdown of our sample by switching and qualification categories. While 23.28% (27/116) of switchers received a qualified opinion, 10.10% (178/1762) of non-switchers also received a qualified opinion. And a higher proportion of companies with a qualified opinion (13.17%) switched auditors than those with a clean opinion (5.32%). The chi-square statistic rejects the null hypothesis of independence of switching and the issuance of a qualified opinion, with a p-value of less than 1%.

Table 2 presents the means and standard deviations for companies with qualified and unqualified opinions, and for switchers and non-switchers separately. The p-values for significant differences in means (proportions for dummy variables) are presented in columns 3 and 7. Corresponding p-values for non-parametric tests of inter-sample differences are shown in columns 4 and 8. Companies with qualified opinions are financially less sound than those with unqualified opinions, as reflected in their distress and growth levels, higher liabilities/assets ratios, a higher incidence of loss, higher residual standard deviation of returns, and lower market-adjusted returns. However, companies with qualified opinions have lower beta, receivables/assets and inventory/assets ratios than those with unqualified opinions. Like companies with qualified opinions, switchers show signs of relatively greater financial distress than non-switchers (as suggested by the p-values for DISTRESS and LOSS), although the difference is not as marked as for qualified and unqualified companies. Finally, companies with qualified opinions and switchers are smaller and are less likely to be audited by Big Six auditors than those with unqualified opinions and non-switchers, respectively.

The univariate tests above suggest that switchers and companies with qualified opinions have some similar characteristics. We turn now to a test of the simultaneity hypothesis. We first present estimates of the qualification and switching models under the assumption of no simultaneity. Table 3 presents the estimates of the switching model. The chi-square statistic, which measures the model's overall fit, is statistically significant with a p-value of 0.000. Clients with qualified opinions are significantly more likely to switch auditors subsequently, a finding consistent with previous studies such as Chow and Rice (1982), Craswell (1988) and Citron

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[12] Most empirical papers on qualifications analyse the going concern opinion. Because the Dopuch et al. study includes different types of qualifications (as in our study), we base our variable choice on that work.

Table 2
Descriptive Statistics by Qualification Type and Switching Status

	Qualification type (QUAL)				*Switching status (SWITCH)*			
	Mean (std. dev.)		*p-value*		*Mean (std. dev.)*		*p-value*	
Variable	*Qualified* (1)	*Unqualified* (2)	*Para-*[a] *metric* (3)	*Non-para-*[b] *metric* (4)	*Switchers* (5)	*Non-switchers* (6)	*Para-*[a] *metric* (7)	*Non-para-*[b] *metric* (8)
INDSHARE	0.128 (0.130)	0.140 (0.136)	0.209	0.068	0.132 (0.140)	0.139 (0.136)	0.557	0.221
GROWTH	0.156 (0.364)	0.261 (0.439)	0.001	0.000	0.224 (0.419)	0.251 (0.434)	0.520	0.580
DISTRESS	0.171 (0.319)	0.012 (0.082)	0.000	0.000	0.063 (0.188)	0.027 (0.136)	0.007	0.008
ACQUISITION	0.000 (0.000)	0.013 (0.111)	0.107	0.157	0.017 (0.131)	0.011 (0.103)	0.522	0.376
PUBOFFER	0.249 (0.433)	0.288 (0.453)	0.239	0.251	0.310 (0.465)	0.282 (0.450)	0.513	0.524
BIG6	0.863 (0.344)	0.933 (0.250)	0.000	0.000	0.828 (0.379)	0.932 (0.252)	0.000	0.000
SIZE	2.872 (2.727)	4.234 (2.112)	0.000	0.000	2.820 (2.097)	4.168 (2.211)	0.000	0.000
REC/ASSET	0.133 (0.127)	0.184 (0.138)	0.000	0.000	0.168 (0.146)	0.179 (0.137)	0.421	0.210
INV/ASSET	0.129 (0.166)	0.168 (0.160)	0.001	0.000	0.153 (0.168)	0.164 (0.161)	0.459	0.218
LIAB/ASSET	0.712 (0.511)	0.491 (0.232)	0.000	0.000	0.531 (0.281)	0.514 (0.285)	0.530	0.591
LOSS	0.732 (0.444)	0.292 (0.455)	0.000	0.000	0.595 (0.493)	0.323 (0.468)	0.000	0.000
BETA	1.029 (0.800)	1.173 (0.700)	0.006	0.003	0.949 (0.718)	1.171 (0.710)	0.001	0.000
SDRET	0.047 (0.026)	0.036 (0.018)	0.000	0.000	0.043 (0.022)	0.037 (0.019)	0.001	0.000

Table 2 *(continuation)*

RET-MRET	−0.076 (0.287)	0.009 (0.221)	0.000	0.000	−0.014 (0.294)	0.0005 (0.226)	0.509	0.547
TIME	0.366 (0.483)	0.402 (0.490)	0.323	0.364	0.284 (0.453)	0.405 (0.491)	0.010	0.011
N	205	1,673			116	1,762		

[a] p-value (two-tailed) for t tests.

[b] p-value (two-tailed) for Wilcoxon two sample tests (Fisher's exact tests for dummy variables).

QUAL = 1 if qualified opinion, 0 otherwise.

SWITCH = 1 if the client switched auditors in the following year, 0 otherwise.

INDSHARE = Share of the auditor (in clients' sales) in the client's industry. Two-digit industry classifications were used except in cases where the number of observations for an industry was less than five, when the corresponding one-digit classification was used.

GROWTH = 1 if the firm falls in the top quartile of growth rate of assets, 0 otherwise.

DISTRESS = F(X) where F(.) is the cumulative distribution of the standard normal and X = −4.803 − 3.599*ROA +5.406*FINL − 0.1*LIQ, ROA = Net Income/Total Assets, FINL = Total Debt/Total Assets, LIQ = Current Assets/Current Liabilities (source: Zmijewski (1984), Table 3).

ACQUISITION = 1 if a company's common stock acquisition exceeded 50% within 18 months before, and up to 6 months after the fiscal year end, 0 otherwise.

PUBOFFER = 1 if public offerings were made in the recent past or are going to be made in the near future, 0 otherwise.

BIG6 = 1 if auditor is a Big Six auditor, 0 otherwise. Pre-merger firms are included as part of the post-merger firms.

SIZE = Natural logarithm of book value of total assets ($m) at the fiscal year end deflated by implicit price deflator for GNP.

REC/ASSET = Ratio of receivables to total assets.

INV/ASSET = Ratio of inventory to total assets.

LIAB/ASSET = Ratio of total liabilities to total assets.

LOSS = 1 if net income is negative, 0 otherwise.

BETA = Beta, the slope coefficient of the market model regression. Source: *CRSP*

SDRET = Residual standard deviation of returns from market model regression. Source: *CRSP*

RET-MRET = Common stock returns (including dividends) minus equally weighted market return (%). Source: *CRSP*

TIME = 1 if the company has been listed on the NYSE, AMEX or NASDAQ for more than five years, 0 otherwise. Source: *CRSP*

Table 3
Probit Estimates of the Switching Model Assuming no Simultaneity

Variable	*Parameter estimate*	*t-statistic*
Dependent variable: SWITCH		
CONSTANT	−0.807	−4.948
QUAL	0.296	2.104**
INDSHARE	0.583	1.591
GROWTH	−0.115	−1.005
DISTRESS	−0.049	−0.163
ACQUISITION	0.322	0.842
PUBOFFER	−0.012	−0.118
BIG6	−0.405	−2.611***
SIZE	−0.130	−5.076***
Chi-square	57.171	
(p-value)	(0.000)	
N-switchers	116	
N-total	1,878	

*** Significant at the 1% level; ** significant at the 5% level;
* significant at the 10% level (two-tailed).

The dependent variable, SWITCH, takes the value 1 if the client switched auditor in the following year and 0 otherwise.
See Table 2 for description of other variables.

and Taffler (1992). Large clients are less likely to switch auditors, and auditees of Big Six audit firms are less likely to switch than those of non-Big Six auditors. High expected growth and financial distress (DISTRESS) do not have significant effects.[13] One explanation for this is that the qualification variable captures their effects.

Table 4 presents probit estimates of the qualification model. As noted earlier, we include SWITCH in a standard qualifications model. The chi-square statistic is significant, with a p-value of 0.000. Small companies, those with greater liabilities/assets ratios, losses and residual standard deviation of returns are more likely to receive qualified opinions. Receivables/assets ratios and market adjusted returns are related negatively to the qualification probability. Of particular interest in this table is the finding that SWITCH has a significant positive coefficient. Previous studies have not included this variable in qualification models.[14] This coefficient may suggest that clients that switch auditors are more likely to have received qualified opinions from their predecessor auditors than those that do not switch. However, since these estimates do not consider the simultaneous relation between the audit opinion and switching, it may simply reflect the basic positive correlation between them already established in Tables 1 and 3.

Simultaneity Between Switching and Qualification

The results so far suggest that a qualified opinion influences switching, as found in some earlier studies. However, the qualification model estimates reveal that receipt of a qualified opinion is itself influenced by client switching. Since the causation may run in either or both directions, a simultaneous equations approach to estimation

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[13] To check the sensitivity of our results to DISTRESS, we also re-estimated our model using (instead of DISTRESS) the three financial ratios: net income/total assets, total debt/total assets, and current assets/current liabilities. Like DISTRESS, none of these variables was significant.

[14] One exception is Krishnan (1994), in which an ordered probit qualifications model is estimated, with different threshold values specified for switching and non-switching clients. While the model used in Krishnan (1994) is not directly comparable to that used in this study, our findings are consistent with Krishnan's result that switchers are treated more conservatively than non-switchers.

Table 4
Probit Estimates of the Qualification Model Assuming no Simultaneity

Variable	*Parameter estimate*	*t-statistic*
Dependent variable: QUAL		
CONSTANT	−1.720	−8.350
SWITCH	0.297	1.923*
SIZE	−0.134	−4.763***
REC/ASSET	−1.447	−3.701***
INV/ASSET	−0.477	−1.304
LIAB/ASSET	1.222	7.214***
LOSS	0.600	5.487***
BETA	−0.097	−1.484
SDRET	6.637	2.674***
RET-MRET	−0.004	−2.298**
TIME	0.327	3.026***
INDUSTRY DUMMIES[a]		
Chi-square	319.110	
(p-value)	(0.000)	
N-qual	205	
N-total	1,878	

*** Significant at the 1% level; ** significant at the 5% level;
* significant at the 10% level (two-tailed).

The dependent variable, QUAL, takes the value 1 for qualified opinions, 0 otherwise.
See table 2 for description of other variables.

[a] Six one-digit industry dummy variables were used. Only two of them were significant: retail (−0.644, t = −2.600) and transportation (0.464, t = 2.875).

would help in sorting out the true effect. Table 5 presents the simultaneity-adjusted results for switching. The results are similar to those in Table 3. One exception is that ACQUISITION now has a significant positive effect on switching, suggesting that changes in ownership can motivate switching. Adjustment for simultaneity does not affect the behaviour of QUAL: the receipt of a qualified opinion has a positive (significant) effect on the likelihood of a subsequent switch.

In Table 6, we present the simultaneity-adjusted estimates of the qualification model, i.e., the probability of a qualified opinion given the switch. Again, the qualitative results are similar to those in Table 4. An interesting result is that the SWITCH variable remains significant even after simultaneity is considered. Also, the point estimate of the effect of switch on qualification (the coefficient on the SWITCH variable) is considerably higher after adjustment for simultaneity, suggesting that ignoring simultaneity results in an underestimate of the effect of switching on the qualifying probability.

As discussed before, the exogeneity test of qualification in the switching process is a test of the null hypothesis that the coefficient of SWITCH (γ_2) in the qualification equation is zero. The fact (noted in the last paragraph) that this coefficient is statistically significant rejects the exogeneity hypothesis, suggesting the existence of simultaneity (or a two-way causation) between the audit opinion and switching.

To the extent that the SWITCH variable is a reasonable proxy for the client's ex ante propensity to switch auditors, our results are inconsistent with the assumption in analytical studies that the possibility that a client will switch deters the auditor from issuing a qualified opinion. Instead, we find that a client who is more likely to switch auditors is more likely to have received a qualified opinion. One explanation for this (Krishnan, 1994) is that the SWITCH variable captures private information (not captured by other variables in the qualification model) that auditors use to issue qualified opinions. Another explanation is that a switch signals the possibility of greater scrutiny by the au-

Table 5
Simultaneous Equations Estimates of the Switching Model

Variable	*Parameter estimate*	*t-statistic*
Dependent variable: SWITCH		
CONSTANT	−0.602	−3.695
QUAL	0.190	2.168**
INDSHARE	0.495	1.341
GROWTH	−0.031	−0.248
DISTRESS	−0.326	−0.900
ACQUISITION	1.016	1.934*
PUBOFFER	0.027	0.249
BIG6	−0.367	−2.380**
SIZE	−0.113	−4.009***
Chi-square (p-value)	57.625 (0.000)	
N-switchers	116	
N-total	1,878	

*** Significant at the 1% level; ** significant at the 5% level;
* significant at the 10% level (two-tailed).

The dependent variable, SWITCH, takes the value 1 if the client switched auditor in the following year and 0 otherwise. See Table 2 for description of other variables.

ditor and greater risks of litigation and reputation loss, possibly making auditors more cautious in their treatment of accounting/auditing issues.

Conclusions

The literature on auditor switching has examined the role of the prior year opinion in determining such switching. No consensus has emerged as to whether the issuing of a qualified opinion causes clients to switch auditors. While empirical work has focused on the opinion's effect on switching, analytical work has hypothesised that the possibility of a switch by the client may make an auditor reluctant to issue a qualified opinion. This study examines the possibility that the causation between the audit opinion and switching may run in both directions.

We estimate a simultaneous equations model of qualifications and switching. The results confirm previous findings of a qualified opinion's positive effect on the propensity to switch auditors. In addition, we find that qualification is not exogenous to the switching process, as assumed in previous work. Using clients' ex post switching behaviour as a proxy for their ex ante probability to switch auditors, we find that a client receiving a qualified opinion is more likely to switch auditors than one who receives an unqualified opinion.

While we find evidence of a two-way causation, our results do not support the suggestion in analytical studies that switching may cause auditors to issue qualified opinions less often. Over the last decade, considerable concern has been expressed that the threat of a switch by the client may impair auditor independence (e.g., SEC, 1985).[15] The Public Oversight Board has recently formed a special advisory panel to look into these auditor independence issues (Public Accounting Report, 1994). To the extent that our models capture the qualification and switching decisions, our results are relevant to policy-makers. However, one limitation of our study is the assumption that the actual observed switch (in the year following the year of analysis) captures the ex ante threat of a switch as viewed by the auditor in the year of analysis. Consequently, our analysis does not capture situations where threatened switches result in the issue of favourable opinions, whereupon the clients decide not to switch auditors.

A fruitful area for future research is the investigation of cases of threatened switches that do not materialise because the auditor agrees to give a clean audit report. Clearly, further exploration of the simultaneous relation between switching and

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[15] Also see SEC (1974) and Barlas (1994) for related discussions of concerns about auditor independence.

Table 6
Simultaneous Equations Estimates of the Qualification Model

Variable	*Parameter estimate*	*t-statistic*
Dependent variable: QUAL		
CONSTANT	−0.799	−1.642
SWITCH	0.784	1.998**
SIZE	−0.059	−1.079
REC/ASSET	−1.413	−3.014***
INV/ASSET	−0.277	−0.564
LIAB/ASSET	1.141	5.676***
LOSS	0.328	1.646*
BETA	0.047	0.418
SDRET	6.842	2.121**
RET-MRET	−0.006	−2.445**
TIME	0.344	2.437**
INDUSTRY DUMMIES[a]		
Chi-square	321.330	
(p-value)	(0.000)	
N-qual	205	
N-total	1,878	

*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level (two-tailed).

The dependent variable, QUAL, takes the value of 1 for qualified opinions and 0 otherwise.
See table 2 for description of other variables.

[a] Six one-digit industry dummy variables were used. Only two of them were significant: retail (−0.901, t = −2.754) and transportation (0.536, t = 2.469).

the prior year audit opinion is required before conclusive policy implications can be derived.

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Evolution of the Application of Present Value to Valuation of Non-monetary Resources

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Abstract—The purpose of this paper is to report the outcome of research that sought to answer the question: what were the significant steps in the evolution of the application of present value to valuation of non-monetary resources? The research findings challenge the generally accepted legend that the application of discounting to economic problems involving non-monetary resources did not occur until the 19th century. The findings show that the application of discounting progressed from 'pure-monetary' resources, such as loans and annuities, to 'semi-monetary' resources, such as land, where there were contractually agreed cash inflows and non-contractual outflows, and finally to 'non-monetary' resources, where there were no contractually agreed cash flows. It is reported that in the aftermaths of the execution of Charles I and the Great Fire of London, property investment was facilitated by a heightened understanding of the calculation and use of discount tables. Another significant 17th-century stimulus was an ongoing discourse that sought to encourage landowners to establish and maintain plantations to satisfy the navy's timber needs. An important outcome of this nationwide discourse occurred in 1730, when an Exonian surveyor and accountant used present value to solve the valuation problems of standing timber under both sustained and intermittent management.

Introduction

Accounting writers present a generally accepted history of the application of discounting to non-monetary resources, and they stress the importance of the calculative technique to the development of the accounting profession's reputation and status.

Johnson and Kaplan (1989, p. 163) held that 'adoption of the discounted cash flow approach for evaluating capital investment projects has been the main innovation in management accounting practice during the past 60 years'. They cited a well-known management accountant who opined that 'engineers had been tinkering with cash flow discounting for years' (Shillinglaw, 1980, p. 6). They recounted that:

> 'The time value of money concept had been used in the actuarial literature since the early 19th century and appeared prominently in the political economy literature earlier in the 20th century. But the discounting of future cash flows as a management tool for evaluating new investment proposals did not emerge until the 1950s' (Johnson and Kaplan, 1989, p. 163).

A writer on the other side of the Atlantic contributed a similar reconstruction:

> 'Discounting techniques were in existence long before they came to be represented as a management tool for the evaluation and comparison of investment proposals. Principles of compound interest were firmly established in actuarial practice as early as the 16th century ... More recently, developments in engineering and political economy in the late 19th and early 20th centuries articulated distinctively modern ways of representing and calculating based on discounting and the use of present value' (Miller, 1991, p. 740).

A revised version of this history was presented by Miller and Napier (1993, p. 640), who found that 'discounting techniques are relative newcomers to accounting' and that:

> 'The introduction of discounting techniques into accounting was one of the key innovations of the post-war years that helped to construct management accounting out of cost accounting. This far from insignificant shift in terminology was of crucial importance in assisting accountants as an occupational category in its rise through the corporate hierarchy' (Miller and Napier, 1993, p. 641).

Given the perceived importance of discounting to the rise of the accounting profession, it is important that teachers and students have access to an accurate reconstruction of significant steps in the evolution of the application of present value to valuation of non-monetary resources. It is also important that they are aware of the roles played by enlightened individuals who knew the accounting methods of their times. This paper is designed to fulfil these needs.

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In this paper, an historical research question is addressed: what were the significant steps in the application of present value to valuation of non-monetary resources? The methodology required an exhaustive literature search of monographs in English, and a limited search of works in other languages. The search provided leads to original documents at the British Library and the Public Record Office in London, and county record offices at York, Exeter and Reading. Early British authors' and publishers' predilection for composing long descriptive titles, which were subsequently reproduced in catalogues, facilitated the selection of books for scanning.

The literature search drew on catalogues by Watt (1824); Donaldson (1854); Canney and Knott (1970); Bolton (1975); Pollard and Redgrave (1976); and Wing (1988), supplemented by the British Library *Catalogue of Printed Books* and the *National Union Catalog* of the US.

At the outset, it was realised that the time value of money is an intersection at which writers from diverse disciplines meet. Aspects of the history of interest have been documented by historians (Ehrenberg, 1928; Habakkuk, 1952, 1958; Clay, 1974; Allen, 1988). Theologians, ethicists and jurists (Noonan, 1957; Nelson, 1969; and Holdsworth, 1966) have cast a different light on the history of interest; as have mathematicians, actuaries and engineers (Waller Zeper, 1937; Hawawini and Vora, 1980; Lewin, 1970; Smith, 1967). From the accountant's viewpoint, the histories of economists, agriculturalists and merchant bankers (Fisher, 1907, 1930; Leadam, 1923–26; Nisbet, 1923–26; Neher, 1987; Homer and Sylla, 1991; Samuelson, 1976; and Gane, 1968) cover more familiar ground. Gane (1968, p. 5) ventured the opinion that 'there can be no doubt that the concept of *net present worth* grew up over a considerable number of years amongst foresters in Austria and Germany'.

One accounting writer (Parker, 1968, p. 58) offered a different interpretation. He compared the application of discounting to monetary and non-monetary assets and noted that 'the extension of discounted cash flow to investment in fixed assets came much later and was based on the work of engineers and economists'. In contrast, another accountant, in conjunction with a business historian, suggested that 'the use of interest may well have its origins in landed estate accountancy' (Edwards and Newell, 1990, p. 52).

The paper comprises four parts. The first part presents a brief survey of milestones in the application of discounting to pure-monetary resources, that is, amounts paid and received in fulfilment of financial contracts, such as loans and annuities. In the second part, evidence is cited in support of the argument that the application of discounting to semi-monetary resources, such as land which generated contractual cash inflows and at the same time incurred cash outflows that in general were non-contractual, evolved from the need to value land. It is shown that a significant step occurred in England in the 1540s during the reign of Henry VIII. At this time, auditors were required to use contractual future cash flows as the basis for the determination of selling prices of previously confiscated monasteries and other ecclesiastic properties. In the third part it is shown that the rulers following Henry VIII stimulated the evolution by selling freehold and leasehold property, and in the aftermaths of the execution of Charles I and the Great Fire of London, investments in semi-monetary resources were facilitated by a heightened understanding of the calculation and use of discount tables. Significant 17th century discourses are cited to show the concern of those in power with the high cost of borrowing and the impact of interest on investments in forestry and other land improvements. In the fourth part it is shown that discounting was used to value non-monetary resources. Here, attention is concentrated on John Richards, who, in 1730, extended the use of discounting to valuation and management of standing timber.

Milestones in the application of discounting to pure-monetary resources

Smith (1967), Waller Zeper (1937) and Lewin (1970) identified early milestones in the evolution of the application of discounting to monetary resources. The chronologies of Smith (1967) and Waller Zeper (1937) reached back to near pre-historic times, and concluded at the beginning of the 17th century. Smith (1967) described the evolution of tables and methods of calculation needed to evaluate financial contracts. He cited the Law of Moses recorded in Deuteronomy (xxiii, 19), 'Thou shalt not lend upon usury to thy brother; usury of money, usury of victuals', from which arose Christian opposition to lending at interest. He drew on Evans (1936), and associated bankers' needs with the calculation of compound interest tables by Pegolotti in Florence about 1340. He noted that Pacioli (1494) solved compound interest problems and cited interest tables. He mentioned Henry II of France and his borrowing at Lyons from German and other bankers in the mid-16th century, and the subsequent publication of compound interest tables by Trenchant (1566). He briefly illustrated or amplified other early milestones: Leonardo Pisano in 1202; Cardan and Tartaglia about 1530 and 1560 respectively; and the publication of the first discount tables by Stevin (1582). Where modern accountants prefer to use the term present value, Simon Steven used *ghereedt ghelt*, that is ready money, to denote values derived from discount tables.[1] Smith (1967) showed that writers in England made an entry subsequent to the pioneering work done on the continent. An entry that started with Witt (1613), whose name suggests a connection with Flanders or Germany.

In his doctoral thesis, Waller Zeper (1937, p. 5) found that an evolutionary root came from the same source as Hindu-Arabic notation. He cited translations of the fifth and sixth century mathematical works of Aryabhata and Brahmagupta by Clarke (1930) and Colebrooke (1817), respectively, which dealt with problems and solutions involving interest. Waller Zeper (1937) also drew attention to other Netherlanders who followed Stevin (1582). The chronologies of Smith (1967) and Waller Zeper (1937) showed that important successive steps in the application of discounting to financial contracts and the calculation of tables occurred at major banking centres in Italy, France and Flanders.

Where Smith (1967) and Waller Zeper (1937) left off, Lewin (1970) started. Lewin (1970) provided a bibliography that listed nearly 30 English authors who, in the 17th and 18th centuries, published treatises that explained how to solve interest problems. He dealt specifically with the contribution of Witt (1613), who presented 124 worked examples involving cash inflows and outflows that were solved by the use of compound interest and discount tables. The first table showed 'what 1^{li}. due at the end of any Number of yeares under 31 is worth in ready money' (Witt, 1613, p. 44). The 121st problem solved by Witt (1613, pp. 178–79) offset amounts paid by two individuals on behalf of the other. In effect, the solution demonstrated the calculation of a net present value. It is worth noting that the author used T accounts to illustrate this problem and its solution. Witt (1613) concentrated his attention on annuities and other financial contracts. Even so, he did consider problems involving semi-monetary resources. Five of his worked examples (Questions 11, 12, 63, 81 and 108) showed how to lessen or increase the amount of annual rent by increasing or lessening the amount of a fine.[2]

Within a year of the publication of Witt's (1613) treatise, the editor of *Records Arithmeticke*, the *vade-mecum* of mathematics masters, prepared a new edition of the text which included a short section on ready money problems (Norton, 1615, preface). The problems were solved by referring to a ready money table 'taken out of Symon Stevens Arithmetick' (Norton, 1615, p. 581). Previous editions of *Records Arithmeticke*, including those published in 1582, 1590 and 1596, were edited by John Mellis, who also edited a well-known early English treatise on double-entry (Mellis, 1588). John Mellis added the 11th chapter of the third part of *Records Arithmeticke*, which demonstrated the importance of the time value of money to buying and selling merchants' operations. The chapter featured worked examples in which interest was merged with gross profit derived from trading in merchandise. An internal rate of return for a year was determined, assuming payment for the purchase was made at the beginning of a year and cash from the sale was received at the end. These worked examples did not consider problems involving periods of more than 12 months, and compound interest calculations and tables were not required.

Norton's (1615) reproduction of Simon Stevin's ready money table was not error free, and attempts were made to correct errors in later editions. The errors were subsequently criticised by Thomas Clay, who published editions of his treatise on interest in 1618, 1622 and 1624. Clay (1624, preface) found fault with those who published 'false and erroneous Tables' that would 'direct the ignorant lender how to defraud himselfe'. Clay's (1624) work included a set of duty statements for the various officers employed by nobles and the landed gentry to manage their estates. The officers included: surveyor, solicitor, bailiff, woodward, storer, receiver, household steward and auditor (Clay, 1624, pp. 57–92). The woodward was expected to minimise the life cycle of standing timber, that is the intermittent management period: 'To see that the Woodfals be made at seasonable times, for the more speedy renuing and growing againe, to the best advantage of the Lord' (Clay, 1624, pp. 77–8).[3]

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[1] The *OED* cites an early 15th-century source in which 'ready money' was used to denote 'cash, as being immediately available for use'. In 1588, John Mellis associated value and ready money: 'Putting the value of them, how much they be, after the common price in ready money' (*OED*). The term 'present money', another precursor of 'present value', appeared in print in 1600 (*OED*). Edmond Halley, the first writer to combine the effect of interest and probability in connection with the duration of human life, used the term 'Years Purchase' to head columns that showed 'the Value of Annuities for every Fifth Year of Age' (Halley, 1693, p. 603). Hayes (1726), an 'Accomptant and Writing-Master' wrote didactic treatises that treated bookkeeping, customs duties, interest, bullion and investments in securities. He used synonymously 'Years Purchase', 'present Worth', 'present Money' and 'present Value'. Richards (1730, pp. 90–91) used both 'ready Money' and 'present Value'.

[2] The term fine was used from the early 16th century to denote 'a sum of money paid by an incoming tenant in consideration of a low rent' (*OED*).

Witt (1613) and two later writers, Phillippes (1653) and Primatt (1667), made important steps towards the application of the concept of ready money to non-monetary resources. These writers applied the concept to the valuation and determination of cash flows in fulfilment of contracts to sell and to lease property. In contrast, other early 17th century writers—Penkethman (1624), Webster (1629), Oughtred (1647), Jager (1651) and Clavell (1653)—concentrated on pure-monetary resources such as annuities and loans.

Semi-monetary resources—the 16th century and before

Since time immemorial, the generally agreed value of land has been based on its yield. In biblical times, yield was measured by the amount of corn or other produce harvested each year, or its annual rental in cash or cash equivalent. The Third Book of Moses laid down a standard for the determination of the transfer price of rights to the produce of land: 'According to the multitude of years thou shalt increase the price thereof, and according to the fewness of years thou shalt diminish the price of it: for according to the number of years of the fruits doth he sell unto thee' (Leviticus 25, 16).

Habakkuk (1952, p. 44) cited evidence from the 13th century showing that the capitalised value or selling price of arable land and other property was determined by multiplying the annual rental by some generally accepted factor. Rogers (1884, p. 288) cited a valuation made of Lord Cromwell's property in 1469 and found that annual rentals totalled £2,097, which produced a valuation of £41,940; that is, 20 times the annual rental. In the first half of the 16th century, during the reign of Henry VIII (1509–47), land values continued to be valued by multiplying the annual rental by 20. This factor was referred to in documents and statutes as '20 years' purchase'.

Habakkuk (1952, p. 33) cited a provision of 31 Hen. 8 c. 4 that provided compensation to owners of land in Exeter whose estates were lost because of works required to improve river navigation. The words of this 1539 act required the value of estates to be determined by 20 years' purchase unless a case could be made for another rate: 'The rate of 20 years' purchase or as much as shall be adjudged by the Judges of Assize'.[4] The provision for the use of another rate provided some leeway.

In the 1530s, the marriages of Henry VIII caused a breach with Rome. In 1539 Henry, the 'Defender of the Faith', dissolved the monasteries and subsequently ordered the sale of many of the monastic estates at a standard price. The price was determined by the capitalised value of rental income recorded in a survey of 1535 known as the *Valor Ecclesiasticus.* The *Valor Ecclesiasticus* was 'used as the standard by which all assessments on the Clergy were regulated' (Caley and Hunter, 1810, Vol. 1, p. iii). Youings (1954, p. 23) reported that sales of monastic estates 'appear to have begun in earnest quite early in 1539'. A commission issued to Thomas Cromwell and Sir Richard Rich, Chancellor of the Court of Augmentations, required them to sell crown lands 'for ready money at 20 years' purchase'. A third commission issued in 1543 contained similar provisions and auditors appointed by the Court of Augmentations were required to use the 20 years' purchase method.

Some auditors appointed to value properties for the Court of Augmentations realised the deficiencies associated with the method. 'In one instance an auditor felt moved to add a memorandum to the effect that the lessee of some demesne was making a profit of 75% above the rent he was paying' (Youings, 1954, p. 25). The auditors knew that capitalisation of rental at 20 years' purchase provided only a base valuation. Against this valuation, the prospective purchaser had to offset expected expenditure for repairs, maintenance and emoluments to the various officers who managed the estate.

Habakkuk (1958) pointed out that this method was also deficient because it did not take into account that many annual rentals were likely to increase subsequent to the expiry of current leases. The auditors' rough and ready answer to this problem was to increase the number of years' purchase. No evidence has been uncovered that showed auditors discounted rental income where leases were subject to reversion; that is, computed market prices that were based on the present value of an annuity plus that of a deferred perpetuity, the annuity being the current annual rental, and the deferred perpetuity being the expected and higher annual rental to be set at the end of the reversionary period. This necessary development in the application of discounting to semi-monetary resources emerged sometime in the hundred years that followed the dissolution of the monasteries. In the next section of the paper, it is shown that such calculations were used implicitly to determine minimum purchase prices for leases in reversion, which were set by several acts of the Interregnum.

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[3] Clay (1622, title) described himself as a 'Surveyer, and Student in the Mathematickes'. He did not disclose that he had practical experience as an auditor on the vast estates of Lord William Howard of Naworth Castle near Carlisle. The belief that Thomas Clay had previously been an auditor is based on circumstantial evidence. Ornsby (1878) edited a selection of Lord William Howard's *Household Books* from which historians of accounting, Jones (1917), Littleton (1961, p. 45) and Brown (1968, p. 88), noted that the auditor of the house steward's accounts for the year 1612 was 'Thos. Clay'. The accounts were made up by Thomas Widmerpoole, Lord Howard's steward. Jones (1917, p. 27) commented that the steward 'appears to have been a learned man. He captions his orderly accounts in Latin'. Such a learned man contributed an octet in Latin that followed Clay's (1622) preface. The writer of the octet was 'Tho: Widmerpoole'.

[4] Ring (1970, pp. 254–55) showed that the same calculative technique is used by modern property valuers to determine 'present worth'.

In the mid-16th century the attitude of the ruling class to lending at interest changed. The attitude was reflected in the words of Norton (1615, p. 579): 'Although usury ought not to bee found amongst Christians: yet seeing our hearts are growne to that hardnesse ... most Common-weales have though not allowed, yet, winked at this usury, only curbing the horrible excesses'. This important change facilitated and encouraged the development and application of calculative techniques that measured the time value of money. Prior to the reign of Henry VIII, lending at interest had been prohibited throughout England and in other lands of Europe that were subject to the Pope's power (cf. Noonan, 1957; Holdsworth, 1966). Despite ecclesiastic and popular objections, lending at interest was recognised by the English parliament in 1545.

In the preamble to the *Bill against Usury*, parliament declared that due to 'many Doubts, Ambiguities and Questions' the laws against lending at interest could not be enforced. Furthermore, because of the risk that money lent under illegal contracts might not be recoverable, the mortgage rate was too high. As landowners came from the same class as those who sat in parliament, it is not unexpected that parliament sought to control the interest rate. By 37 Hen. 8 c. 9 they set a maximum rate of 'ten Pound in the Hundred' at which money could be lent on mortgage. No doubt the number of buyers prepared to pay the prices set by the king's auditors was bolstered when buyers were permitted to borrow at interest in order to finance their purchases.

Elizabeth I (1558–1603) emulated her father, and hundreds of land transactions that enriched the exchequer were recorded in the *Calendar of the Patent Rolls*. Elizabeth found that crown lands were being leased at lower than current market rents and she demanded information about current values (Habakkuk, 1958, p. 371). For example, in 1599–1600, the Queen's Surveyor conducted a survey of Settrington manor in the East Riding of Yorkshire. His survey compared the existing annual rent and the potential or 'true annual value' (King and Harris, 1962, p. 39). The surveyor found that the potential return on the Queen's forests was too low. He recommended that it was 'most proffitable for her Majestie to sell all her Tymber & vnderwood And to lett out the grownds for pasture' (King and Harris, 1962, p. 95).

Semi-monetary resources—the 17th century

At the end of the 16th century, the greatest Elizabethan dramatist wrote *The Merchant of Venice*, which evoked his audiences' ambivalent attitudes towards usurers. In another play, Shakespeare drew on a commonplace aphorism which indicated a well-known impact of interest on farmers: 'Neither a borrower, nor a lender be; For loan oft loses both itself and friend, And borrowing dulls the edge of husbandry' (*Hamlet*, I, iii, 75). An early 17th century farmer, Robert Loder, who had inherited the Princes Harwell manor in Berkshire, felt the pain Shakespeare warned of. Loder's farm journal showed that he was troubled when his assets, which he had financed by a loan at 10%, were idle. He calculated a cost for the 'use of my stocke which lay dead, from the time I made an ende of sowing until I had it in my barne' (Fussell, 1936, p. 22; cf. Parker, 1980, p. 263). This usage of imputed interest was not 'proto-discounting' (cf. Miller and Napier, 1993, p. 640). Yet Loder did make one isolated attempt to compute the present worth of money to be received sometime in the future. In 1612 he considered the costs and benefits of keeping 500 sheep for six months from 1 May 1611. He calculated the value of the wool at the end of the season. He also calculated the marginal increase in three successive crops resulting from spreading the dung excreted by the 500 sheep. He valued the marginal increase in the yield at £5 a year for three years. He recorded his analysis in his farm journal:

> 'I reckon that my dounge wilbe worth unto me the summe of xv*l.* in iij cropes; for I judge it will dounge V landes but it is worth of present money I judge (at xv*l.* in iij crops) viij*l.* xs.' (Fussell, 1936, pp. 40–1)

This seems to be an example of a farmer who entered into a financial contract, who understood the concept of discounting, and extended his analysis to the financial aspect of the management of a semi-monetary resource. His discounting of cash to be received from production activities was insightful. It does not appear to have been emulated by writers of didactic treatises until the next century, when a surveyor from Exeter applied the concept to timber production (Richards, 1730). Nor did Loder, in the eight years that followed, make another recorded attempt to use the concept of present money to evaluate his management decisions.

Loder's usage was isolated and presumably had no impact on others. In contrast, a political discourse by Sir Thomas Culpeper the elder attracted the attention of parliament (Culpeper, 1621). He showed clearly that he understood the deleterious impact of a high interest rate on the evaluation of investment projects such as forestry and land improvements. In his opinion, the wealth of England was not being developed because the interest rate was too high in comparison to that in other nations. He stated that 'the rate of usury is the measure by which all men trade, purchase, build, plant, or any other waise bargaine', which clearly indicates that he and others understood the impact of interest on the acquisition, utilisation and disposition of semi- and non-monetary resources (Culpeper, 1621, p. 6).

Culpeper (p. 17) was concerned that those with money would not invest in land or improvements such as planting because 'the rate of money now is above the rent of Land, purchased at fourteene or fifteene yeeres purchase'. That is, the cost of borrowing at 10% was higher than the amount of rent that the land returned. He appreciated the sensitivity of parliament to the need to ensure that the nation had sufficient timber to build its ships. English built bottoms were essential for trade and war. He developed his argument on the need to improve land and to preserve woods. He argued:

> 'It hath beene the wisdome and care of former Parliaments to provide for the preservation of Wood and Timber; for which there is nothing more available than the calling downe of the high rate of usury; for as the rate of mony now goeth, no man can let his timber stand, nor his wood to grow to such yeeres growth as is best for the Commonwealth, but it will be very lost-full to him: The stocke of the woods after they are worth forty or fifty shillings the Acre, growing faster at ten in the hundred then the woods themselves do.' (Culpeper, 1621, p. 6).

That is, landowners compared the cash flows derived from immediate felling of standing timber trees to the expected cash flows from felling at some time in the future. Culpeper (p. 6) understood risk and the need to use a higher interest rate where an investment project involved hazards and uncertainty:

> 'And for shipping, which is the strength and safety of this land; I have heard divers Marchants of good credit say, that if they would build a shippe, and let it to any other to imploy, they cannot make of their money that way, counting all charges, teare and weare, above ten or twelve in the hundred, which can bee no gainfull trade without hazard, money it selfe going at ten in the hundred.'

In conclusion, he showed his knowledge base included an understanding of how to sway the opinions of those in power. The parliament at this time represented the interests of the monarch, the nobility and the landed gentry. He wrote:

> 'Now because I know mens private interest doth many times blinde their judgements, and least any may be tempted for their owne, against the publique good; I will desire them to remember, that if they have Lands as well as money, that what they loose in their money they shall get it in their land; for Land and money are ever in ballance one against the other, and where money is deere, Land is cheape, and where money is cheape, Land is deere' (Culpeper, 1621, pp. 19–20).

His endeavour was rewarded: in 1623 parliament passed an act entitled *An Act against Usury* (21 Jac. 1 c. 17), which set the maximum rate of interest at 8%. His contention regarding the relationship between the cost of money and the price of land might have impressed the Stuart kings. Tawney (1941, p. 25) found that James I (1603–25) and Charles I (1625–49) divested themselves of land worth £775,000 and £650,000 respectively.

The reign of Charles I was terminated by the parliamentary forces led by Oliver Cromwell. In 1647, parliament sought to raise funds by selling confiscated ecclesiastic properties (Fraser, 1973, p. 310). An act of the Interregnum dated 17 March 1647/48 provided for the sale of leaseholds in possession and in reversion. Phillippes (1653, p. 31) described a lease in reversion as one in which 'the thing yields no profit for the present, till some considerable term of years be passed'. The provisions of this act and others that followed, including *An Act for sale of the Honors, Manors, Lands heretofore belonging to the late King, Queen and Prince*, passed on 16 July 1649, showed an understanding of how discounting could be used to determine a set of minimum prices that offered approximately similar rates of return.

The 1649 act set a minimum price of freehold land at 'Thirteen yeers purchase' (Firth and Rait, 1911, Vol. 2, p. 176). This rate is equivalent to an interest rate of 7.69%, which was slightly lower than the legal rate of 8%. The minimum price of a seven-year lease in reversion was 'Six yeers and a halfs purchase'; a 14-year lease in reversion 'shall not be sold under Four yeers and a quarters purchase'; and the minimum price of a 21-year lease in reversion was set at three years (Firth and Rait, 1911, Vol. 2, p. 177).

If it is assumed that the leases in reversion, dealt with by the act, were in effect deferred perpetuities, then discount rates or internal rates of return can be calculated. For the three guidelines expressed in terms of seven, 14 and 21 years' purchase, the internal rates of return were 8.62%, 8.01%, and 7.42% respectively, and all other things being equal, the best deal was to invest in leases that had only seven years to run before the buyer acquired the right to occupy or relet the property. If the legal rate of 8% had been used to determine the number of years' purchase, then the minimum prices would have been 7.29, 4.26 and 2.48 years' purchase instead of 6.5, 4.25 and 3, respectively.

Given the complexity of the calculations required to evaluate the various options, it is not unexpected that an attempt was made by an author of a didactic treatise to provide an explanation. In 1653, the first of six editions of *The Purchaser's Pattern...* was published. The author stated that his discourse was an endeavour to take away 'the Veil of *Ignorance* ... in the way of purchasing *Land* or *Leases* ... so that all men may make their bargains without fear or danger, and receive just, true and mutuall profit and gain thereby' (Phillippes, 1653, preface). At the outset of the section headed 'Of Reversions', he dealt with risk: 'And in these bargains you must look first into the quality of the thing, and the certainty thereof; and accordingly seek out the value thereof at a greater or lessor rate of interest' (Phillippes, 1653, pp. 31–32). In this section, he provided worked examples that showed how to calculate the worth of a reversion expressed in the same terms as that used in the acts of the Interregnum, that is, years' purchase.

The first example dealt with the purchase of a 'Reversion of a piece of Land'. The method he employed drew on an annuity table. He deducted the value of an existing 21-year lease discounted at 6%, 'which is the rate fittest for Leases of Land', from the worth of the land, 'which is about 20 years purchase', and found that the reversion was worth 'eight years, and almost a quarter of a years purchase' (Phillippes, 1653, pp. 35–36). He used the same method to show how to calculate at 6% the value of 'a Lease for 60 years, wherein a Tenant hath 21 years already', and found that it 'is worth one year and a quarters purchase, and somewhat more' (Phillippes, 1653, p. 38).

In a later edition, which was 'the same in substance' as the first, he found 'those who are conversant herein, either through want of skill and art to reckon, or care to consider thereof, they set too low a value upon a short Lease, and too high a value upon a long Lease' (Phillippes, 1656, preface). This comment might point to the reason why the minimum prices set by the 1649 act offered a higher return for seven year leases in reversion than 14 and 21. In the 1656 edition, he inserted a new table headed 'Tables of Reversions' and a simple explanation, which in effect showed how to find the present value of a deferred annuity. The 'Table of Reversions' showed the discounted value of 1 expressed in shillings and pence for interest rates of 5%, 6%, 8%, 10% and 12% from 1 to 31 years. The core of the simple explanation ran as follows:

> 'A parcel of land of one hundred pounds yearly rent, being worth 20 years purchase is worth in ready money 2000*li.* ... Now the first table of Reversion shew, that one pound, at the end of one and twenty years is worth but 7*s.* and 2*d.* ready money at the said rate of 5 *li. per cent.* ... this 7*s.* 2*d.* therefore must be added or multiplied 2000 times ... *In all* 716*li. 13s.* 4*d.* ... is the worth of the said reversion' (Phillippes, 1656, p. 59).

The fifth edition of *The Purchaser's Pattern...*, published in 1667, marked another milestone in the evolution of the application of discounting to semi-monetary resources. An extensive preface showed its publication was a direct outcome of the Great Fire of London, which in September 1666 destroyed more than 13,000 houses (Bell, 1920, p. 282). He sought to encourage landlord and tenant to resolve their differences and to rebuild:

> 'Rules and Directions for the Purchasing the Ground Plots and Foundations of Houses lately burned in the City: and for the stating of the Interest and Claims between Landlord and Tenant in the said Foundations, in order to the Building thereof' (Phillippes, 1667, preface).

He was one of many people who responded quickly to the destruction of London. Parliament, supported by the king, sought to ensure that London did not lose its pre-eminence in trade. They encouraged immediate rebuilding. They devised extraordinary measures to counter legal disputes that arose from this extraordinary event, and which left many tenants with an obligation to continue to pay rent and to rebuild at their own cost. Parliament's masterstroke was to set up a Fire Court, which settled differences and encouraged landlords, tenants and new investors to finance the building of a new London (Reddaway, 1951).

Jones (1966, Vol. 1, p. xiii) found that 'The work of the Court was greatly aided by counsel who endeavoured to bring the parties to agreement'. Counsel and the court followed a set of rules without which 'there might have otherwise followed such an endless train of vexatious Suits, as might have been little less chargeable than the Fire itself had been' (Burnet, 1682, p. 56). An indication of the principles the judges used was provided by Stephen Primatt, who in October 1667 sought to satisfy the needs of parties who wished to make an equitable settlement without recourse to the Fire Court (Primatt, 1667). Primatt had a chamber at Clifford's Inn, where the Fire Court conducted its sessions. Primatt dedicated his treatise to three of the Fire Court judges, and the implicit acceptance of the dedication suggests that Primatt's treatise had the court's imprimatur. That is, that the principles explained in the treatise were consistent with those used by the judges in the determination of their settlements. Burnet (1682, pp. 56–57) attributed the setting down of principles to Sir Matthew Hale, who sat on 70 cases in the first 16 weeks of the Fire Court's existence:

> 'He was most instrumental in that great work; for he by way of Scheme contrived the Rules upon which he and the rest proceeded afterwards; in which his readiness at *Arithmetic*, and his skill in *Architecture* were of great use to him.'

The literary works of Sir Matthew Hale indicate that he possessed arithmetic skills necessary to understand and apply mathematical principles. In 1673 he published *An Essay Touching the Gravitation and Non-gravitation of Fluid Bodies*. He was also familiar with contemporary accounting methods; in 1683 he produced *A Short Treatise Touching Sheriffs Accompts*.

The index to Primatt's (1667) treatise summarised the principles that he explained. They included: 'How to compute the value of lands'; 'How many years purchase, and what may be given for land in fee simple, for terms of life, or years'; 'A table, showing the value that may be given for a lease, from one year to an hundred, for ten pound per annum'; and 'How to compute the value of ground whereon houses stood before the late fire'. Primatt (1667) did not confine his attention to the valuation of land and buildings in London and the terms of leases. He made a seminal contribution in the application of the concept of discounting to non-monetary resources. He recognised that the Great Fire provided an opportunity for investors to take money out of existing investments and to re-invest in London property:

> 'In the first part, there is a treatise of Purchasing Lands and Houses, and of other things in England, which I thought necessary, for that some men sell their Lands and other things, to the intent to bestow their Money in Building' (Primatt, 1667, preface).

The 'other things' included important non-monetary resources: mills, clay ground suitable for making bricks, coal, lead and tin mines. In regard to coal mines he advised that the price should be based on the annual profit (Primatt, 1667, pp. 26–29). He noted the risks, such as flooding, involved in such investments and advised that a colliery that had a 20-year life might be valued at three or four years' purchase. He mentioned some flooded mines that had attracted buyers who found 'that instead of dreining the Water, their Pockets are dreined' (Primatt, 1667, p. 29). He also considered investments in impropriations, that is, ancient rights to receive rents that had belonged to the church and had been taken away from them by Henry VIII. Primatt (1667, p. 25) advised that due to scruples and conscience they were of less value. He rated them at 14 years' purchase if near London, 'and in remoter parts at 12 or 13'. Primatt (1667, p. 25) made clear that the annual income on which the years' purchase was applied ought to be a net amount: 'You must make deduction for the Fee-Farm rent to the Crown, and for maintenance of Cure'; that is, the annual rental paid to the crown and the curate's annual salary.

The short time it took to rebuild London was a striking demonstration to the rest of Europe of the knowledge and commercial power of the city's merchants and financiers. This important outcome of the Great Fire was noticed by Burnet (1724, Vol. 1, p. 260):

> ... to the amazement of all Europe, London was in four years time rebuilt, with so much beauty and magnificence, that we who saw it in both states, before and after the fire, cannot reflect on it without wondring where the wealth could be found to bear so vast a loss as was made by the fire, and so prodigious an expense as was laid out in the rebuilding it.'

This evaluation, together with the Fire Court's activities, suggests strongly that another important outcome of the Great Fire was that the application of discounting to valuation and investment in semi-monetary resources became widely known and accepted in the legal, business and banking communities. Given this knowledge, it seems reasonable to conjecture that there was a spillover at this time, and those who invested in non-monetary resources, such as shipping, mining and manufacturing, might have considered discounting's application to their business operations.

Another outcome of the Great Fire was renewed discourse about the rate of interest and its impact on investment in semi- and non-monetary resources. Sir Thomas Culpeper the younger followed his father's example and sought a further reduction in the interest rate. Culpeper's (1668) discourse advanced a case in favour of a reduction in the current rate of 6% to 4%. He based his case on a number of heads, including 'It only can rebuild London, Profitably as to the Builder, speedily as to the Publick' and 'It only can prevent the fatal destruction of our timber'. His words under the latter head support a contention that landowners understood and used discounting to assist them in the financial aspects of managing their woodlands:

> 'However, Certain it is, That the present Age is so well versed in Arithmetick, as to compute, That scarce any Timber can be permitted to stand, but to great loss in the Forbearance; Whereby, All that owe Money, or

> marry Daughters, do but discreetly (if they may) to strip their Estates to the last stick; And we all know, how few Landlords are now exempt from both these conditions: So that one would almost marvel, how there should be any Timber left standing and thriving, where the reasons for felling are so urgent, and the encouragements for preserving it so slender' (Culpeper, 1668, p. 18).

Culpeper (1668, p. 18) concluded his argument with an assertion that if interest were lower then 'many Gentlemen' would preserve their young timber trees and plant new groves for prosperity.

Non-monetary resources—the 18th century

The future timber needs of the nation and its navy did not go unnoticed by some of the great landowners. In the 18th century, substantial plantations of native or exotic timber trees were established by enlightened lords of the manor (Tansley, 1968, pp. 39–40; Vancouver, 1808, pp. 245–70). Given some landowners' propensity to establish plantations, and the general acceptance of using discount tables to value land, buildings and leases, it is not unexpected that sooner or later a didactic treatise writer would attempt to explain the use of the same technique to value separately the worth of timber trees.

In 1730, John Richards extended the use of discounting to the valuation of trees. He used the term present value to denote the discounted values that he calculated. Richards was a surveyor, who also acted 'as a Steward and Accomptant' (*Exeter Flying Post*, 9 January 1778). The coupling of offices appealed to small estate owners who sought professional assistance. Clay (1622, p. 80) advised 'one man may supply both the places of learned Steward and Solicitor; and another, being capable thereof, may supply the places of Surveyor & Auditor'. Richards' (1730) treatise showed that he applied his skills to a wide range of problems involving valuation using the present value concept. The problems included valuing lives after the actuarial methods of Halley (1693) and de Moivre (1725), and the valuation of freehold and leasehold estates.[5] Prior to explaining how to value a coppice, which comprises trees grown for periodic cutting, Richards (1730, pp. 86–88) discussed the growth rate and valuation of trees that are harvested at maturity. He determined the natural growth rate of an oak from aged 50 years to maturity at 100 years. He found that at 50 years an oak of 12 inches in diameter yielded 100 feet of timber; at 100 years the diameter of the oak had doubled, the height increased and the yield was 480 feet. From these estimations, Richards (1730, p. 88) found that an oak's growth rate was 3.19% and compared unfavourably to a contemporary interest rate of 6%. This estimate was consistent with Culpeper's view (1621, p. 6) to the effect that the cost of money grows 'faster at 10 in the 100 than the woods themselves do'.

In the next section of his treatise, Richards (1730, pp. 90–1) considered the management and valuation of trees grown for periodic cutting. He presented worked examples that showed how to solve two valuation problems. The first example illustrated a solution to a simplified version of the 'intermittent management' problem considered by von Gehren (1849) and Faustmann (1849); the general solution to which is now 'widely known to foresters as Faustmann's soil expectation value formula or, more briefly, as Faustmann's formula' (Gane, 1968, p. 8). Under intermittent management, a whole forest of timber trees or a coppice is harvested at the end of each rotation period. In the example used by von Gehren (1849) and Faustmann (1849) the forest rotation period was 65 years. A coppice, which produces wood for poles and staves rather than timber, has a shorter rotation period. Richards (1730) used a 15-year period.

Richards' (1730) second example considered a problem of 'sustained management' where a coppice of 210 acres was subdivided into 15 parcels each of 14 acres. Under sustained management, a parcel is harvested each year in perpetuity. Except for a minor typographical error, and a failure to include outgoings such as establishment and annual production and administrative costs, Richards' (1730) calculations are correct and his analysis, as far as it goes, is in accord with Faustmann's.

Further evidence of Richards' knowledge and extension of present value to non-monetary resources is provided by a survey he conducted in 1735 for a local lord of the manor, John Worth of Worth (Devon Record Office, 49/9/1/488). John Worth held extensive estates in Devon, including the manor of Worth, which was located on the River Exe about three miles north of Tiverton. The survey showed that Worth's estates to the north and west of Exeter included both demesne and land leased out. The demesne holdings included woods and coppices as well as the lands on which Worth's manors stood.

The Worth survey was an outstanding management report. It was presented in an eight column calligraphic format which showed:

1. Tenure—leased out or demesne.
2. Name of tenant, field or coppice.
3. Number of lives of lease.
4. Value of land.
5. Value of timber.

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[5] Halley became the Astronomer Royal in 1720 and is known as the 'father of modern geophysics'. De Moivre 'came next to Halley as the founder of a science of life-contingencies', and his work on *The Doctrine of Chances* clarified the concept of probability (*DNB*).

6. Reserved rents.
7. Reserved heriots.
8. Value of the lord's interest.

The contents of columns 4, 5 and 8 are of particular importance to the case presented in this paper. Two instances are cited that showed Richards valued separately both land and timber. The first instance was the valuation of Bartingdon Manor in the parish of Staverton near Totnes. Richards calculated and showed the value of land (column 4) as £105; the value of timber (column 5) as £350; and the value of the lord's interest (column 8) as £2,450 (DRO, 49/9/1/488, p. 7). While there were no workings shown, it is clear that the value of the lord's interest was determined by adding the capitalised value of the annual rental to the value of timber. At 20 years' purchase, an annual rental of £105 has a capitalised value of £2,100. How Richards determined the value of timber at £350 is unknown; it is possible that he used the present value calculation technique that he explained in his treatise (Richards, 1730, pp. 90–91). The second instance was a valuation of six demesne coppices on the manor of Fairby, north of Tiverton. Richards calculated and showed the value of land (column 4) as £15.10s; and the value of timber (column 5) as £226. Unfortunately, the right side of the page is damaged and only the first digit, a five, in column 8 is legible (DRO, 49/9/1/488, p. 12). If Richards used 20 years' purchase, then the value of the lord's interest was £536, being £15.10s by 20 plus £226.

Richards' (1730) application of discounting to the financial management and valuation of timber trees and coppices does not appear to have been emulated or extended by other English didactic treatise writers in the 18th and early 19th centuries. This omission might be explained by the fact that the creation of plantations was the preserve of wealthy landowners, and there would have been little prospect of making a profit from publishing and selling a specialised didactic treatise in such a limited market.

Conclusion

In this paper the important steps in the evolution of the application of discounting to valuation of non-monetary resources have been described and analysed. In the second part, evidence from the 1540s was cited showing clearly that the concept of years' purchase was used to determine the selling prices of estates confiscated by Henry VIII. In the next part, citations were made of discourses, didactic treatises and statutes, which clearly indicated that investors used the concept of ready money in their analysis of investment opportunities in land and buildings arising in the aftermaths of the execution of Charles I and the Great Fire of London.

In the last part, it was shown that the publication of a seminal treatise, providing worked examples of the valuation of a coppice under both sustained and intermittent management, was the result of a continuing discourse about the need to establish plantations. Finally, a good case has been made on which to advance the conclusion that the use of the concept, known today as present value, was extended to semi-monetary resources in the mid-17th century and to non-monetary resources in 1730.

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Audit Standards and Auditor Liability: A Theoretical Model

Marleen Willekens, Anthony Steele and David Miltz*

Abstract—The business of auditing is heavily regulated. Auditor regulation exists through licensing, professional standards and liability. The auditor's liability for losses to financial statement users from audit failure is subject to a test of negligence. What constitutes due audit care is, however, not generally well-specified. Furthermore, reviews of litigation against auditors conclude that compliance with professional audit standards does not always act as a complete defence to allegations of negligence. The current situation can be described as one where (ex ante)—from the point of view of the auditor—uncertainty exists about the 'legal' standard of due audit quality (as seen by the courts in the event of litigation). This uncertainty about legal standards fundamentally affects audit behaviour in ways that are not immediately intuitive. This paper draws on insights from the economics and law literature (e.g., Kolstad et al., 1990; Shavell, 1984a, 1984b and 1987; Calfee and Craswell, 1984 and 1986) and provides an analysis of the effects of uncertainty about auditor negligence on the produced level of audit quality and on audit fees. The auditor subject to a negligence rule will produce too low or too high an audit quality level, as compared to the socially optimal level. It is shown that uncertainty about the legal standard of 'due audit quality' is fundamental to understanding audit quality supplied. This uncertainty is the explicator of an insurance component in audit fees. A surprising insight is that a large uncertainty about the legal standard of care can reduce rather than increase the quality of audit work supplied and increase the insurance component. Relying on insurance premiums can be more effective than direct expenditure in reducing risk. The effect of the imposition of ex ante precise audit quality standards, in combination with an uncertain negligence rule, is discussed. Since the influence of ex ante standards is indirect through its effect on ex post liability, auditing standards cannot be analysed independently of 'legal' standards. If the legal standard of care were clear, there would be no role for audit standards. Audit standards only affect audit behaviour if legal standards of care are unclear, and they help to clarify the legal standard. An effective combination is for ex ante standards to be set below the ex post standards of care so that they provide a lower bound on acceptable work. Under a lowest common denominator approach set too far below legal standards, audit standards would be irrelevant as far as operational decisions were concerned. As the level of standards are raised, so costs are first imposed on the lowest quality providers.

Introduction

The market for financial statement auditing services is characterised by heavy regulatory intervention. Not only is demand for auditing services subject to statutory requirements for many firms, but the production and supply of audit services is also regulated through licensing, professional audit standards and rules about legal liability. The statutory audit requirement for companies can be seen as a regulatory device to protect financial statement users from losses that might result from decision-making based on defective financial statements. Since public accountants are professionally liable for the quality of their audit work, and face the risk of legal liability, they have an economic interest in providing the 'right' amount of audit quality.

Public accountants are, however, not strictly liable for losses to financial statement users, as their liability is subject to a negligence test. The negligence standard adopted by the courts in the event of litigation is not known with certainty to the auditor at the time that he performs the audit. Even though professional audit standards exist, which may give auditors guidance as to what constitutes reasonable care and skill, they tend to be rather general in nature, and are issued by the audit profession as a form of self-regulation.

The 'looseness' of audit standards has long concerned commentators (Stamp and Moonitz, 1978; Sikka, Wilmott, Cooper and Puxty, 1992). Recently, the UK Auditing Practices Board established a Revisions Task Force to undertake a comprehensive review of all auditing standards and guidelines with the intention of making them more prescriptive (Crane, 1993). This paper shows that auditing standards cannot be analysed independently of legal standards, and that audit standards are an irrelevance in a world in which the legal standard of care is clear. Audit standards affect audit behaviour only if legal standards of care are unclear, and the standards help to clarify the legal standard.

According to the 'public interest theory' (Ledyard, 1991) regulatory intervention (e.g. audit regulation) tries to make an economy more efficient

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if a market is characterised by failure and externalities. Market failure exists if the quantity or quality of a produced good deviates from the social optimum. In the audit market there is informational asymmetry between the quality of audit demanded (by users), paid for (by managers) and supplied (by auditors). The non-observability of audit quality supplied is a key source of market failure, and may justify regulatory intervention. The critical question to address is the efficacy of this regulation, the forms it takes, and whether it is likely to improve efficiency.

This paper will analyse the effects of uncertainty about the auditor's negligence standard on audit quality produced by the auditor and on audit fees, and whether contemporary audit regulations are likely to be efficient, or in other words, how audit regulations relate to the public interest. The analysis draws on insights from the economics and law literature regarding the effect of uncertainty on compliance with legal standards.[1] A basic premise of this literature is that legal rules create implicit prices on behaviour and that individuals' (and organisations') responses to those prices can be analysed in exactly the same way that responses to explicit prices can be analysed (Ulen, 1993).

As the focus is on audit production and *regulation applying to the auditor*, audit demand is treated as given (exogenous) and is assumed to be at the level that the auditee complies with statutory audit requirements.[2] The text is organised as follows. In section two the social objective of auditor regulation is defined in the light of the public interest theory of regulatory intervention, and two alternative viable regulatory policies (i.e. ex post and ex ante policies) are briefly discussed. The third section discusses contemporary regulatory interventions in the market for financial statement audits, and focuses on the uncertainty that exists there. An economic analysis of possible effects of uncertainty about auditor negligence on produced levels of audit quality and on audit fees is provided in the fourth section. The fifth section investigates under which circumstances ex post regulatory policies should be complemented with ex ante policies to achieve the desired social optimal level of audit quality. Finally, in the last section, the major conclusions of the analysis are summarised and some implications of the findings for contemporary auditor regulation are formulated.

Auditor regulation in the light of public interest theory

Auditing as an Externality-generating Activity

In the economics literature (see, for example, Just, Hueth and Schmitz, 1982, p. 269) an externality is defined as the case where an action of one economic agent affects the utility of another in a way that is not reflected in the market price. Losses to financial statement users due to resource allocation decisions based on defects in those statements which the auditor did not detect or report, could be seen as an 'externality' or 'market failure'. This externality is aggravated by the informational asymmetry that delivered audit quality, the level of precaution against hazard, is unobservable. The social objective of audit regulation would then be to correct for externality-generating audit behaviour in such a way that total social utility is maximised. An approach commonly used to determine social optimality in the presence of externalities is *internalisation*. All of the involved economic agents are considered jointly as, for example, in a hypothetical merger of firms. The externality can then be internalised by maximising the joint utility of all economic agents, which is equal to maximising social welfare. The social objective function of auditor regulation could be formally expressed, using internalisation, to minimise the sum of audit costs and expected negative externalities (or losses) to be suffered by users:

$$\min_{q} \quad SC(q) = C(q) + L(q) \cdot p(L \mid q) \quad (1)$$

where the total social cost, denoted by SC (q), is the sum of the audit cost and expected social losses. The audit cost, denoted by C(q), is the cost of gathering audit evidence for a particular client, and is here assumed to be a function of audit quality, q. Audit quality is defined[3] as the level of assurance that accounts are free from material error. The expected losses to users are also assumed to be a function of audit quality and are here defined by the term: $L(q) \cdot p(L|q)$, where L(q) is the size of the losses and p(L|q) is the probability of occurrence of these losses. Under the assumption of a

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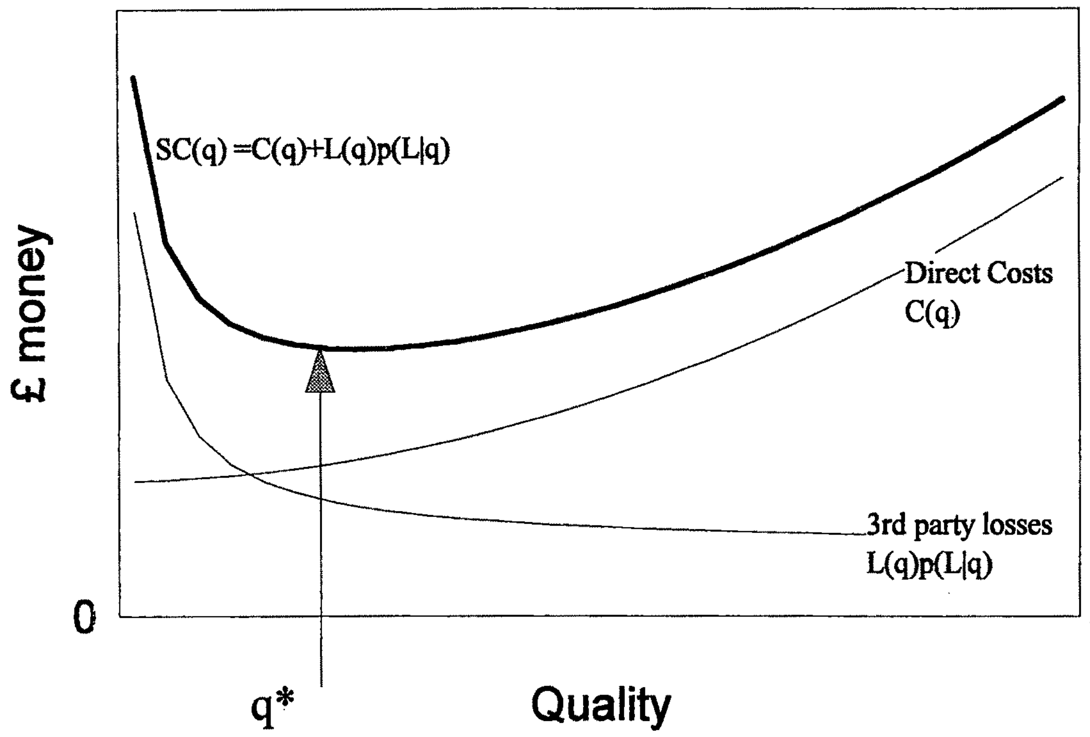
[1] See, for example, Calfee and Craswell (1984), Cooter and Ulen (1988), Kolstad, Ulen and Johnson (1990).

[2] This assumption implies that there is no client demand for audit quality per se, just for a statutory audit. The choice of audit quality is the auditor's. This assumption departs from models in which the demand for external audit is jointly determined with the demand for internal audit. The assumption also abstracts from situations in which the level of damages that can be recovered from the auditor influences demand. The analysis assumes that auditors face unlimited liability, and there are no constraints on their capacity to pay damages.

[3] This notion of quality is consistent with the literature on audit risk models. It is the complement of ultimate or audit risk, for example, AICPA (1981) SAS 39 where variable UR = ultimate risk that financial statements are materially misstated after completion of the audit. In AICPA (1983) SAS 47 the term UR is replaced by AR = the audit risk. In this paper quality is taken as q = 1 − AR.

Figure 1(a)
A socially optimal level of audit quality



social cost function which is strictly convex[4] in q, a socially optimal amount of audit quality, q*, can be derived. As audit services are client-specific, both audit cost, C(q), and losses, L(q), are client specific functions of audit quality, and so will be the social optimum, q*. Government regulation that drives audit quality in the direction of this social optimum can improve social welfare in a Pareto sense.

The problem of externality is graphically represented in Figure 1(a), which shows C(q) as an increasing function of q, L(q) and p(L|q) as decreasing functions, giving SC(q) with an interior minimum at SC(q*). Regulation that aims to change the auditor's private decision from min C(q) subject to $q \geq 0$, towards q*, the level of quality which solves equation (1), would be welfare-improving. A theoretical regulatory regime would be to make auditors into superinsurers, strictly liable for all claims against them from all sources, converting the auditor's decision directly into equation (1). No jurisdiction does this, since the insurance premium, $L(q^*) \cdot p(L|q^*)$, would have to be estimated ex ante by auditors, charged to clients, but the ex post liabilities paid to an indeterminate class of people without consideration of fault or privity. Instead, regulatory regimes control externalities by controlling liability, and requiring a legal standard of care, q_c. The standards of care can be ex ante, clearly known before the audit is conducted, or ex post, revealed by the courts after the hurt has occurred, or, as discussed in the second part of section two, a combination of both ex ante and ex post requirements.

Regulation of liability takes many forms. Under a negligence rule, the auditor is found liable for damages if, only if, the audit quality is less than the legal standard. A negligence rule is defined:

$$N(q) = 1 \text{ if } q < q_c$$
$$0 \text{ otherwise}$$

The size of the losses, L(q), by the principles of privity, may also be restricted to some classes of claimants, $L_R(q)$. Major differences between jurisdictions are in the classes of persons due a 'duty of care'. In the UK, for illustration following the judgment in *Caparo Industries v. Dickman* (1990), the House of Lords' ruling was that a company's auditors did not owe a duty of care to potential investors in the stock market, or to the company's individual shareholders, but to the shareholders as a whole. Variants on a negligence rule include a

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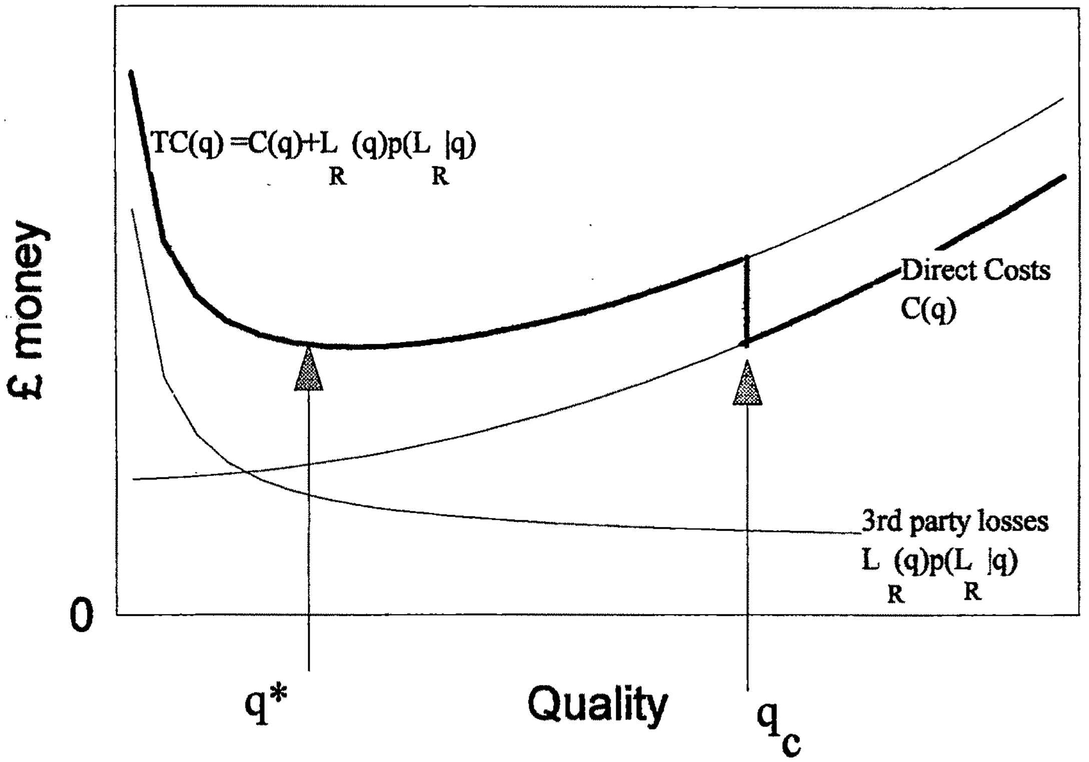
[4] That is: $dC/dq > 0$ and $d^2C/q^2 > 0$ over the relevant range; as well as $dL/dq < 0$ and $d^2L/dq^2 > 0$ over the relevant range. These two statements of decreasing marginal returns for effort combine to justify the convexity assumption.

Figure 1(b)
A choice of audit quality under a negligence rule



statutory capping on the maximum monetary amount of the liability. In Germany, an auditor's liability is limited to DM500,000. Permitting private contractual limitations on liability is another variation to a negligence rule. (In the UK, section 310 of the 1985 Companies Act explicitly voids such contracts.)

Sharing losses under rules of joint liability, prorating losses under several liability rules, reducing losses by applying concepts of contributory negligence, increasing (punitive) losses for exemplary negligence, allowing auditors to trade under the protection of organisational forms that carry limited liability (as companies), are all optional components of a negligence rule. Although the analysis can be extended to encompass these alternatives, this paper deals with auditors subject to joint and several unlimited liability, unrestricted except to classes of claimant.

The auditor's private expected total costs under a negligence rule are given by:

$$TC(q) = C(q) + N(q).\ L_R\ (q).p(L_R \mid q) \quad (2)$$

If the negligence standard, q_c, is known by the auditor, then the auditor's private cost-minimising choice of quality level is shown in Figure 1(b). The important distinction this analysis highlights is that the function being minimised by the auditor is TC(q), and not SC(q). The regulation of liability both alters L(q) to L_R (q), and introduces a discontinuity to TC(q) at q_c. It is a trivial observation that the decision context of the auditing profession described in this way is with legal behaviour, and despite exhortations (e.g. Tinker, 1985) is only concerned with social optima to the extent that it is reflected in the law. A profit-maximising auditor will compare the marginal increase in audit costs with the marginal decrease in expected liability payments, and not with the marginal decrease in social costs. The more realistic situation in which there is uncertainty about the negligence standard is discussed further in the third section of this paper, but the main elements of the analysis are in place: the socially optimal level of quality, q*; the ex post view of the court-required level of quality, q_c; and the level of quality actually chosen by the auditor, q**, which minimises private costs set out in equation (2). It will be useful when discussing uncertainty about the ex post standard, q_c, to identify an ex ante quality standard, q_s.

Ex Ante and Ex Post Regulation as Methods to Correct for Audit Market Failure

In general, two very different regulatory approaches exist to control for activities (such as the production of audit services) that create risks of harm to third parties or externalities: *ex ante regulation* (e.g. safety standards, registrations, prohibitions and so on) and *ex post regulation* (exposure to tort, liability regulation). The first policy instrument modifies behaviour in an immediate way through requirements that are imposed *before*, or at least independent of, the actual occurrence of harm, and are public in nature.

In the context of audit regulation, an ex ante policy that applies to the auditee is the statutory audit requirement. For the auditor, professional audit standards could be seen as an ex ante policy. Those standards are developed by the profession to provide auditors with an aid to fulfil their professional responsibilities and include considerations of professional qualities (competence and independence), reporting requirements and evidence. In most countries, however, auditing standards (as opposed to accounting standards) are very general, in the sense of stressing objectives rather than a means of reaching those objectives. Their power as a legal defence of 'due care' in litigation is uncertain, as they are advisory in nature and do not have the same authoritative and enforcing character as standards set by legislation, for example. Therefore they may be considered as a weak form of an ex ante policy.

The second policy instrument, liability in tort, works through the deterrent effect of damage actions that may be brought *after* harm has occurred, and hence is private in nature. The threat of suit causes the potential injurer, in this case the auditor, to internalise the expected harm and hence to take precaution, or, in the audit case, to produce an appropriate level of audit quality.

The choice between ex ante and ex post policies usually depends on the nature of the activity that is governed. Shavell (1984a) discusses a number of theoretical determinants of the relative social desirability of ex post or liability regulation versus ex ante regulation. These include: (1) the difference in knowledge about risky activities between private parties (externality-generator or injurer), courts and a regulatory authority; (2) the likelihood of incapability of private parties to pay for the full magnitude of harm done; (3) the chance that parties would not face the threat of suit for harm done; and (4) the administrative costs incurred by private parties and the public in using either ex ante direct regulation or the ex post tort system. The first and the fourth determinants have an impact on the cost of using either system. The second and the third determinants have an impact on the private party's incentives to take care and to avoid externality-generating (or risky) behaviour. The application of all four determinants to the audit setting provides a qualitative analysis of the relative desirability of liability regulation versus ex ante audit standards.

For the first determinant (i.e. the difference in knowledge about risky activities between private parties, courts and a regulatory authority), considerations of economic efficiency suggest that regulation should be in the hands of the better informed, or those who can become better informed at least cost. In the audit case, auditors have an informational advantage because of their expertise and their superior knowledge about client specific factors. In reality, general ex ante auditing standards may be too stringent or too lax, or may be too expensive to set, so liability regulation is favoured. Even where the regulator was well informed, pure ex ante standards require one level of care for all cases. This would mean that cases causing little social harm would be over-regulated, and cases involving a lot of harm, under-regulated. The information asymmetries favour ex post liability regulation.

On the second determinant, if private parties are incapable of paying for the full magnitude of harm done, ex ante regulation should be favoured. If the size of the assets at risk is smaller than the magnitude of harm, the injurer's incentive to take care is mitigated. Thus a potential liability many times the auditor's wealth has no more serious consequences for the auditor than a potential liability that only just exceeds the auditor's wealth. Limited liability has the same effect in limiting the capacity of paying for the full magnitude of harm. Ex ante standards would become more important in jurisdictions that allowed auditors to adopt the limited liability form. The purchase of (mandatory or voluntary) liability insurance also exacerbates the disincentive to take care. The insurer needs to link the premium or provide only partial cover or tie other terms of coverage to the injurer's precautions (risk-reducing behaviour) to mitigate this moral hazard problem. In economies in which there was a constrained supply of professional indemnity insurance, ex ante standards would be an important regulatory policy.

Shavell's third determinant (the chance that parties would not face the threat of suit for harm done), also dilutes the incentives to take precautions and hence favours ex ante regulation, if this chance is high. Such a situation may exist when harm is widely dispersed, when it takes a long time before harm manifests itself, or when it is difficult to attribute harm to the injurer. This situation may apply with auditing, since financial statement users are a very vaguely and broadly defined category of people, and the causality of losses to users may be hard to trace. The trend in some countries over the past decades to broaden the category of third party users to whom the auditor owes a duty of care, and the uncertainty that exists in relation to this issue, also favours more precise ex ante audit standards of care.

The fourth determinant (the magnitude of ad-

Exhibit 1
Shavell's Determinants of Regulatory Choice Applied to the Auditing Context

Determinant	*Evaluation*	*Regulatory policy favoured*
Difference in knowledge about risky audit activities as between auditors, courts and regulatory authority	● Informational advantage for audit firm because specialisation and expertise	Ex post liability
Inability of audit firm to pay for the full magnitude of harm	● Exists ● Incomplete insurance coverage and moral hazard problem	Ex ante standards
Chance that audit firms don't face the threat of suit	● Exists ● Harm may be dispersed over many different users ● Causality of losses to users not always clear	Ex ante standards
Magnitude of administrative costs by auditors, users, audits and the public	● Infrequency of use favours tort system ● Increased use of courts favours ex ante standards ● Research and lobbying cost for ex ante standards will be high	Indeterminate

ministrative costs incurred by private parties and by the public in using the tort system or direct regulation), favours the least expensive system for a particular activity. In general, there is an advantage in favour of ex post liability, since its infrequent use limits its cost. Developing national and international ex ante audit standards may entail very large research and lobbying costs. However, if the number of court cases in which auditors are involved rises, the balance of cost advantage may tilt towards ex ante standards.

From the above discussion it would seem that the complementary use of both policies can be justified for regulating auditing. The interaction of ex ante audit standards and ex post liability, when the negligence rule is subject to uncertainty, is discussed in the fifth section of this paper.

Auditor liability: a matter of uncertainty

As auditors' legal liability risk is of crucial importance for much of the analysis in this paper, this issue is discussed in more detail. The acceleration of litigation against auditors over past years, and uncertainty over the scope and nature of auditors' legal liability, has resulted in a substantial body of audit literature analysing their professional responsibilities.[5] Although auditors may be found to have been criminally liable under some circumstances, the major focus of research in this area has been on their civil liability, and the latter is the only concern in this analysis.[6] In principle, the auditor can only be found liable if he or she has been acting negligently. In this context, two important questions require some further comment (Gwilliam, 1987a, p. 134): first, what is negligent auditing (under which circumstances will the auditor be held liable), and second, to whom does the auditor owe a duty of care not to act negligently?

In relation to the first question, an auditor is expected to carry out his or her audits with 'reasonable care and skill'. A general definition of what this exactly embodies is difficult to provide, and the courts have the final jurisdiction over what is and what is not the exercise of reasonable care and skill. As every court case brought against auditors is different, uncertainty exists about which negligence standard courts use in their judgments. Moreover, there is little 'hard' case law covering wide aspects of audit activity, because only a relatively small number of cases relating to audit matters are fully contested through the courts. This is especially true in Europe, but to a lesser extent in the US, where there is a significant body of recent case law. In addition, the applied court standards tend to change as expectations and responsibilities change over time.

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[5] For recent discussions of the evolution of the auditor's professional liability over time through analysis of case law and/or statutory law in the UK and Commonwealth, see Pound and Courtis (1980), Davison (1982). Gwilliam (1987a, 1987b, 1988a and 1988b). For discussions of the evolution of liability over time through analysis of case law and/or US statutory law, see, for example, Davies (1979), Schultz and Pany (1980), Largay and Paul (1983), Minow (1984) and Brecht (1989). For empirical research regarding factors associated with lawsuits in the US, see, for example, St Pierre and Anderson (1984), Palmrose (1988, 1991) and Stice (1991).

[6] The reason is that criminal actions against auditors are rare, and our primary concern is with their liability to reimburse financial statement users for monetary losses due to audit failure, which is governed by auditors' civil liability.

After examining legal evidence, Gwilliam (1987a, p. 157) formulates the following important conclusion:

> '... although compliance with professional standards is an important factor in determining what constitutes reasonable care and skill (and is more likely to act as a complete defence to allegations of negligence in the UK than in US courts) in some areas (e.g. duties in regard to fraud and appraisal of internal control) *courts generally expect more to be done by the auditor than is currently stated or implied by professional standards* [emphasis added].'

Thus, professional audit standards, although they may be seen as a weak form of an ex ante regulatory policy, appear to be used today as a complement to the existing liability regulation. From Gwilliam's analysis it can be derived that the level of audit quality implied by ex ante audit standards is set *below* the ex post legally required level. This conclusion is relevant for the analysis in the fifth section of this paper.

Uncertainty also exists with respect to the second question, i.e. to whom does the auditor owe a duty of care. In the first instance, the auditor has a contractual relationship with his or her client (the auditee), and is liable for losses resulting from negligent auditing. Lack of privity of contract[7] has been a defence for auditors against third party claims for many years. The scope of the auditor's liability has, however, broadened over the years to include third parties. Gwilliam (1987a, 1987b), for example, identified a long-term trend in judicial reasoning in the UK and the Commonwealth, expanding the auditor's duty to: specific third parties known to be relying on the statements; to limited classes of third parties known to be relying on the statements; and to third parties whose future reliance can be reasonably foreseen as a consequence of their dealing with the client. Brecht (1988), after analysing judicial reasoning in precedent-setting US cases deciding duty of care to third parties, concludes that there has been a comparable expansion of the auditor's duty of care to 'foreseen' third parties.

Nevertheless, there are important differences in both legal environments. In the UK, actions brought by third parties against auditors are torts, and hence the auditor's liability to third parties is essentially a matter of common law.[8] In the US, the situation is more complex, as the auditor's liability for harm to third parties was established by statutory law[9] in the 1934 Securities Act, although the option for recourse to common law is also available (a substantial number of court cases against auditors are a question of common law).

One way for the auditor to attempt to alleviate the burden of expanded liability is to seek for apportionment with either their clients or third parties by application of the tenets of contributory negligence.[10] The defence is, however, with the auditor who has to demonstrate that the client or a third party plaintiff has been acting negligently and that this negligence has been a direct cause of the loss he or she suffered.

A final consideration, relating to the expansion of auditors' liability to third parties with whom no contractual relationship exists, pertains to the extent to which courts balance public policies to protect the public interest by providing remedy with public policies protecting the audit profession's capacity to serve the public. Davies (1979) describes the evolution of common law from the privity of contract doctrine towards more liberal doctrines of third party liability as a process of implementing a 'deep pocket theory' of liability placement. He states that various courts' interpretations have often been influenced by individual fact findings and the degree of auditors' liability that would be socially and economically tolerable at that time.

Some effects of uncertainty on compliance with legal standards of due audit care

Negligence Standard Under Certainty

Most analyses of legal liability rules found in the economics and law literature assume that parties subject to a negligence standard know exactly what level of 'due care' is legally required.[11] Such a situation usually creates a strong economic incentive for potential injurers to always comply exactly with the legally required level of due care. Figure 1(b) illustrates this point as applied to the audit context, given that the auditor would know the negligence standard adopted by the court with certainty. The heavy kinked line represents the total costs an auditor will eventually bear. In the event of litigation, auditors who under-complied with the legal standard of due audit care, q_c, will be held liable with certainty and will have to bear the total cost, which is the sum of audit costs and losses to third parties. Those who satisfy the legal requirement will not be held liable at all, even if losses occur to third parties, and will only incur audit costs.

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[7] Privity of contract refers to a direct relationship between two or more parties to a contract. In the audit context, the client and any third party that is named in the engagement letter have privity of contract (Arens and Loebbecke (1984, p. 106). Privity of contract can be seen as the first common law concept that has been applied to a public accounting setting; its application originated in the UK and dates from as early as 1842 (see *Winterbottom vs Wright*).

[8] Laws that have been developed through court decisions rather than through government statutes.

[9] Laws that have been passed by a country's legislative governmental body.

[10] In the UK, the statute applicable in this instance is the Law Reform (Contributory Negligence) Act of 1945; in the US, statutes regarding contributory negligence are a matter of state law, but this tenet is accepted in almost all states. The doctrine is sometimes referred to as comparative negligence.

The degenerate case in which the legal standard of care is too high should also be considered. Suppose legislators set legal standards of due audit care, q_c, at a level considerably in excess of the socially optimal level, q^*. Such a situation is depicted in Figure 1(c), where $q_c \gg q^*$, and $TC(q_c) > TC(q^*)$. In this case the penalty that is avoided by complying with the law is not a sufficiently strong incentive for potential injurers to always comply exactly with the legally required level of due care.[12] If an audit failure causes only a miniscule third party injury, it could be that legal standards were too severe. In that case legal standards would be viewed as 'ridiculous', and the behaviour of economic actors would be unaffected by the law, who would continue to make 'reasonable' choices. In this case legal actors may have incentives to alter the law closer to the social optimum.

The political processes by which legal standards are determined, and their relation to social optima, are important issues. For the purposes of this paper we assume a close alignment between social optima and the law, that is, we identify $q_c = q^*$. The legal standard is regarded as a practical proxy for a theoretical but ultimately political ideal, and audit behaviour is analysed in response to legal standards. It is clear that if the legal standard is set at the socially optimal level of audit care, i.e. q^*, a negligence standard under certainty would always produce the socially optimal level of audit care, due to the sudden jump in the auditor's private cost curve. The first proposition can now be stated.

Proposition 1:

The optimal choice of audit quality for an auditor subject to a negligence standard that is known with certainty will be on the legal minimum, assuming that the courts set the audit quality standard at the socially optimal level.

Proof is clear from inspection of Figure 1.

Corollary 1:

Under a certain negligence standard, optimal audit fees will not contain any insurance risk premium.

Assuming competitive audit markets,[13] the auditor's minimum supply price per unit of q would be equal to the marginal cost, and his minimum fee would be equal to his incremental expected *total* cost. The corollary follows directly from noting at the optimum that the total cost does not contain an expected liability for negligence (which is priced as an insurance premium). The insurance premium would not be priced in a competitive market.

Uncertain Negligence Rule

Auditors do not, however, know with certainty what the legal standard of due audit care or its application will be in the event of litigation. The legally required level of audit care in the following discussion is defined as q_c plus a random variable, ε, about which the auditor has some subjective beliefs. The random variable has a subjective probability distribution $f(\varepsilon)$, with a mean of zero, and a standard deviation σ. The random variable is realised when the court delivers a judgment, a realisation that the auditor only conjectures when executing an audit. The auditor's subjective probability distribution around the legal standard is here defined as: $f(q) = f(q_c + \varepsilon) = q_c + f(\varepsilon)$. The result of this is that the auditor faces some probability that he will have to pay losses to third parties if his actual level of audit care is below q_c. Similarly, he also faces some probability that he might still be found liable even if he took care above the expected legally required level, q_c.

The auditor's liability is thus given by:

$$N(q) = 1 \text{ if } q < q_c + \varepsilon$$
$$0 \text{ otherwise}$$

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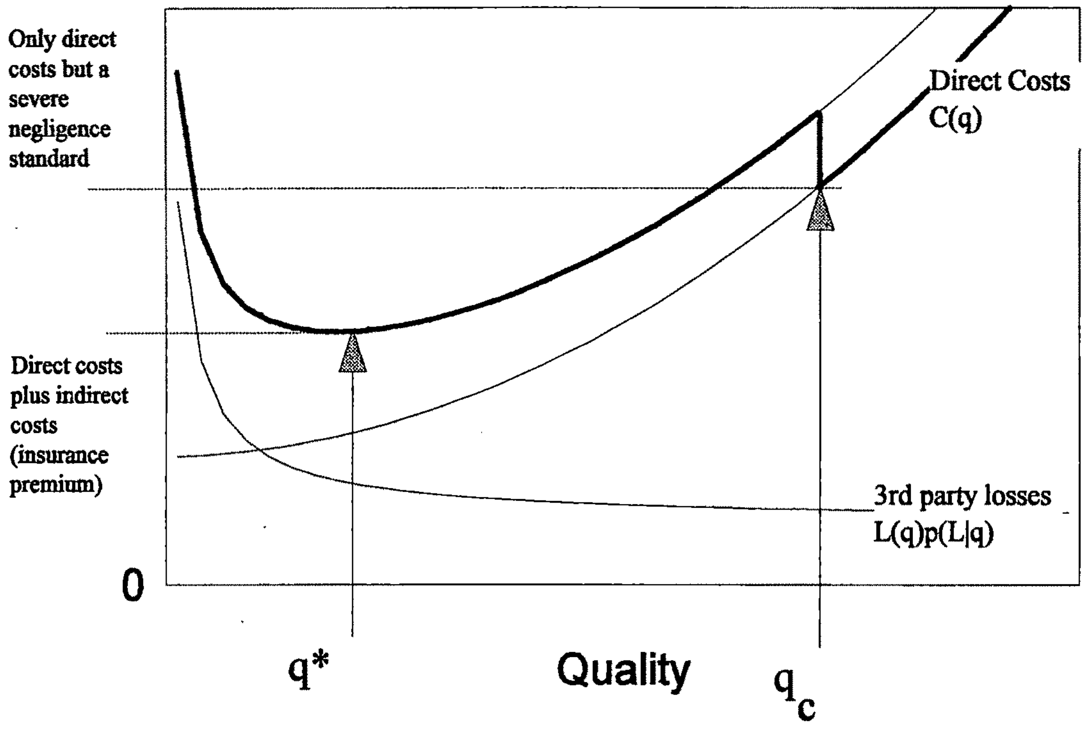
[11] See, for example, Brown (1973), Diamond (1974) and Shavell (1984a, 1984b, 1987).

[12] An interesting illustration of this in an accounting context is the implementation of the European Union directive for companies to publish accounts. In Germany, the fine for failing to comply is such that over 80% of companies prefer to pay the fine and not to file accounts.

[13] This assumption appears to conform with reality. Empirical evidence in support of price competition in audit markets is provided by: Simunic (1980, 1984), Palmrose (1986a and 1986b) and Francis and Simon (1987) for the US market; Chan, Ezzamel and Gwilliam (1991) for the UK; Firth (1985) for New Zealand; and Francis (1984) and Francis and Stokes (1986) for Australia.

Figure 1(c)
A choice of audit quality under a severe negligence rule



where ε is the realisation of the random variable.

The probability of being liable at a choice of quality level q is:

$$R(q) = \int_{q}^{\infty} f(q)\, d\, q$$

The cumulative function R(q) is the probability that when all is said and done, after the court has passed judgment, the auditor will pay damages. The auditor's expected cost function equation (2) now becomes:

$$TC(q) = C(q) + R(q).\ L_R\ (q).p(L_R \mid q) \quad (3)$$

Figure 2 shows how the certainty case in Figure 1(b) is changed. There is no longer a step discontinuity in the total cost curve at q_c, because N(q), the step function in equation (2), is replaced by the cumulative density function R(q). The total cost curve now presents the auditor with a gamble:

$$TC(q) = C(q) \text{ with probability } (1 - R(q))$$

OR

$$C(q) + L_R\ (q).p(L_R \mid q) \text{ with probability } R(q)$$

whose expected value is given by equation (3). Consider the situation in which the auditor is risk neutral to the size of the gamble being presented, as might be the case under audit independence rules, which preclude the auditor from being overexposed to any one particular client as a source of fees.

TC(q) is strictly convex by assumption and thus has a unique minimum. Denoting q**, as before, as the auditor's level of quality which minimises equation (3), the first order condition for minimisation is:

$$TC'(q^{**}) = C'(q^{**}) + R(q^{**})A'(q^{**}) - f(q^{**})A(q^{**}) = 0 \quad (4)$$

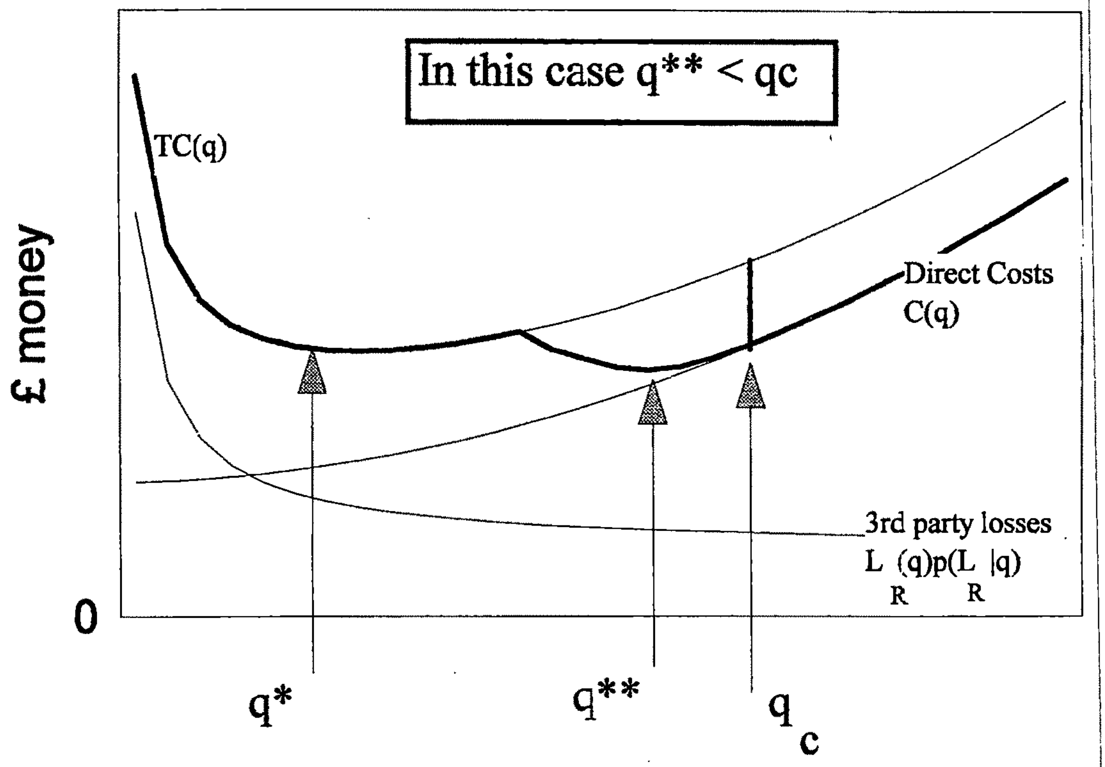
where $A(q) = L_R(q) \cdot p(L_R|q)$

This gives the marginal conditions at the minimum as:

$$C'(q^{**}) = -R(q^{**})\ A'(q^{**}) + f(q^{**})\ A(q^{**}) \ (5)$$

The interpretation of this condition requires the auditor to equate the marginal cost of providing the q**th unit of quality to the sum of two terms arising from the negligence liability rule. The first term is the marginal reduction in damages times the probability of being held liable if the level of audit quality is q**. This is the 'injury effect' and represents the savings to the auditor from the application of greater precaution in reducing expected damages. The second term is the 'liability effect', the product of the expected damages and the change in probability of liability. The liability effect represents the benefit the auditor derives from a greater level of precaution in reducing the

Figure 2(a)
A choice of audit quality under an uncertain negligence rule



probability of being found liable.

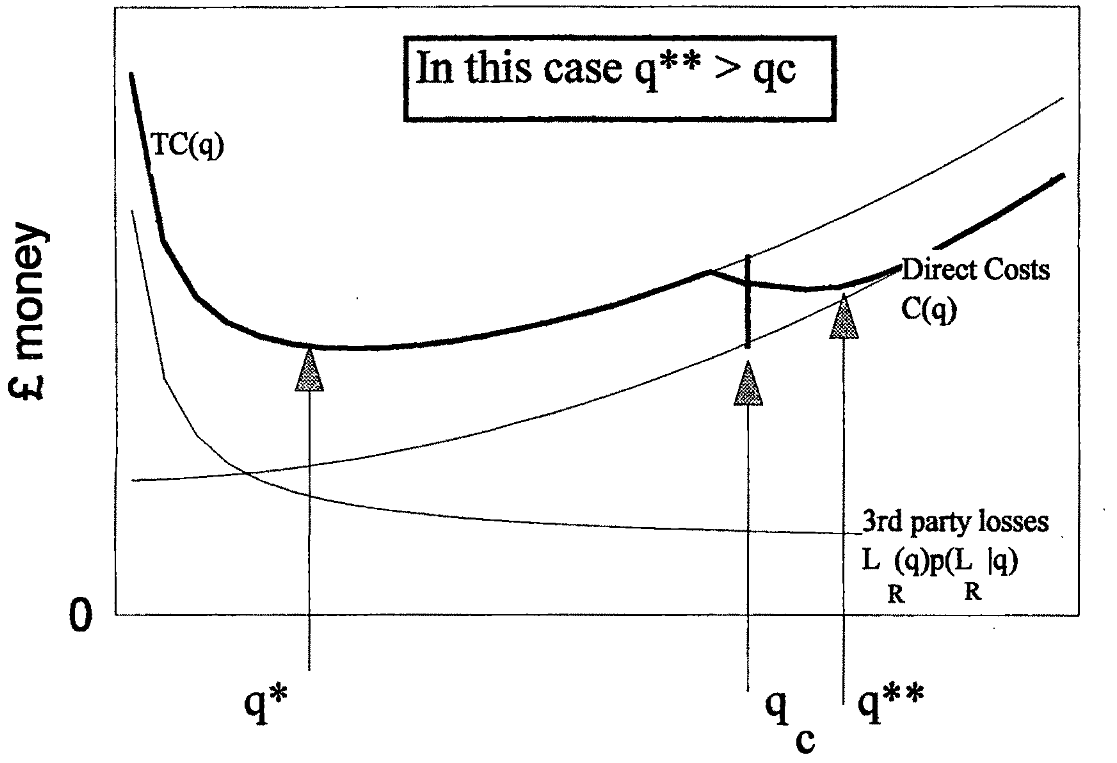
Proposition 2
Uncertainty about the legal standard of care can increase the level of audit quality but can also reduce the level of audit quality an auditor will choose.

Uncertainty can cause the optimal private choice of audit quality to be greater or less than q_c. Other than a requirement for unbiased expectations ($E(\varepsilon)=0$ so that $E(q)=q_c$), there are no restrictions on $f(\varepsilon)$. The step function in the certain liability test is replaced by an S-shaped cumulative distribution when the ex post liability test is subject to uncertainty. The range of shapes that cumulative distributions can take means that in some cases the optimum q** is less than q_c, and in other cases more than q_c. Uncertainty has a profound effect on the optimum, and in general one cannot predict in which direction.

To prove the proposition, suppose that there are three auditors indexed by $i=1,2,3$, who agree on all the parameters of a client situation, C(q) and A(q), but who disagree in their subjective beliefs about the due standard of care, using probability functions $f_i(q)$ and $R_i(q)$. Let the first auditor's choice of the optimal amount of audit quality based on $f_1(q)$ take the value $q^{**}=q_1$. It can be shown that the other two auditors will choose to deliver different levels of audit quality, due entirely to the differing uncertainty about the due standard of care. Suppose, for the second auditor, that $f_2(q_i)>f_1(q_1)$ but $R_1(q_1)=R_2(q_1)$. The probability density functions have the same value at the optimal point for auditor 1, but the cumulative distributions differ at that particular point. The beliefs of auditor 2, described by the density function $f_2(q)$, need not be more or less widely dispersed than those of the first auditor, $f_1(q)$; they merely differ. It follows that the value of the RHS of equation (5) will increase, causing the second auditor to choose a level of audit quality greater than q_1.

A similar argument for the third auditor (where $f_3(q_1)<f_1(q_1)$ but $R_3(q_1)=R_1(q_1)$ leads to the third auditor choosing a level of audit quality below q_1. This is the most general proposition. Since beliefs can take any form, the behaviour of an auditor faced with an uncertain negligence rule cannot be predicted without knowing more about those beliefs. The choice of audit quality depends crucially on beliefs about the standard of care required. In order to make more powerful statements about how uncertainty affects audit quality, we need to restrict the nature of uncertainty and the form of $f(\varepsilon)$.

Figure 2(b)
A choice of audit quality under an uncertain negligence rule



Proposition 3 deals with an important class of symmetrical probability functions.

Proposition 3
If uncertainty about the legal standard is normally distributed about q_c, (i.e. $f(\varepsilon)=(2\pi\sigma^2)^{0.5}\exp(-0.5(\varepsilon/\sigma)^2)$), and the optimal choice of audit quality is q_c, then increasing uncertainty will cause the auditor to reduce audit quality below q_c. Conversely, reducing uncertainty will cause the auditor to increase audit quality beyond q_c.

Corollary 2
Increasing uncertainty about the legal standard of care increases the insurance component in audit fees.

From equation (4), if q_c is optimal then $q_c = q^{**}$, and $\varepsilon=0$, $R(q_c)=0.5$ and $f(q_c)=(2\pi\sigma^2)^{-0.5}$.
Equation (4) then becomes:

$$TC'(q_c) = C'(q_c)+0.5A'(q_c)-(2\pi\sigma^2)^{-0.5}A(q_c) = 0 \quad (6)$$

The proof of proposition 3 follows from the observation that at the point q_c, the functions C'(q),R(q),A(q) and A'(q) take particular values that do not vary when uncertainty as measured by σ is changed. Equation (6) is the optimality condition, and by changing the amount of uncertainty, σ, the sign of $TC'(q_c)$, can be changed. When $TC'(q_c)$ is negative, the optimum level of quality is greater than q_c; conversely, when $TC'(q_c)$ is positive, the optimum amount of quality is less than q_c. Increasing (decreasing) uncertainty, σ, will make $TC'(q_c)$ positive (negative).

This proposition, although stated in terms of the auditor's uncertainty about the legal standard being normally distributed, holds for a large class of symmetrical distributions. It is a counter-intuitive result (at least to the writers!). Intuition would have suggested that more uncertainty would have led the auditor to undertake more work. Instead, it is found that more uncertainty reduces the effectiveness of audit expenditure for reducing liability, causing the auditor to optimally choose a lower level of direct cost and a lower audit quality. The indirect liability for expected harm will increase. The pricing of this in a competitive market is via insurance premia. Thus legal uncertainty reduces quality and increases the insurance component in audit fees. The auditor makes a choice and takes his chances. It is not worth doing more work to improve quality levels if the chances of this work being appreciated by the court are not much improved. It is only when uncertainty about the legal standard of care is reduced that the trade off between the amount of work done, and the reduction of risk, favours doing more work. When there is very little uncertainty in the determination of the legal standard, an increase in audit quality results in only slightly higher expenditure, but a greatly reduced likelihood of being held liable and paying damages. Similarly, when there is great uncertainty surrounding the legal standard of care, reducing audit quality saves expenditure while only slightly increasing expected liability costs. With great uncertainty about the legal standard of care, direct expediture by the auditor C(q) is less effective in reducing expected liability, and insurance expenditure more efficient.

The corollary 2 follows as the uncertainty analogue to corollary 1, and relies on the same observation about the structure of total costs and the nature of pricing in a competitive market.

With propositions 2 and 3, it has been established that uncertainty about the ex post legal standard of care is a fundamental explicator of the quality of audit work, profoundly affecting the level of quality chosen, and accounting for the insurance component in audit fees. In the next section, the role of ex ante audit standards is considered, and how these affect delivered audit quality.

Impact of ex ante audit standards

We develop the analogy that audit standards operate in the same role as ex ante safety standards in the control of hazards. Safety standards typically specify a minimum acceptable level of precaution. The situation we analyse is where there is no uncertainty over the ex ante standard, q_s, which is known to the auditor, the regulator and the courts. The manner in which the effect on audit behaviour is modelled is through changing beliefs about the legal standard. The development of audit standards may reflect a political agenda in influencing the court's view about the appropriate legal standard. Certainly the auditor believes that the legal standard of precaution cannot be less than q_s. The auditor may perceive that the legal standard of care exceeds q_s. This appears to be a reasonable approximation to the prevailing relationship between audit standards and the courts.

The manner in which ex ante audit standards change beliefs, we know from proposition 2, is fundamental to analysing their behavioural impact. Audit standards, q_s, which were so much below expected legal standards, q_c, that beliefs were unaffected would be an irrelevance, since they would have no effect on behaviour. Since they did not alter behaviour they would not impose any costs of implementation. A politically weak self-regulatory body, relying on the power of consensus to set audit standards, would write such standards. Recalling the waggish definition of a profession being 'when a craft gets crafty', a strong self-regulating industry might also choose to develop such standards in order to pre-empt effective regulation.

Researchers in critical accounting have commented on the flaws in self-regulation and have criticised the profession's 'monopolistic' regulatory power. Without going into the details of this literature a popular accusation is that self-regulation is used for 'impression management' (see, among others, Neu, 1991 and Byington and Sutton, 1991). In this context, audit standards are perceived to be used to project an image of professional quality, but are not set at a level congruent with third parties' expectations. The insight that our analysis reveals is that on purely technological grounds concerned with the operating characteristics of combining ex ante and ex post regulations, setting ex ante standards weaker than the ex post standards is effective. One need not have recourse to analysing the political context of standard setting to explain this particular characteristic of the regulatory environment in which auditing is conducted.

Readers should note that the remaining results depend on how audit standards are considered to affect beliefs about legal standards. This paper follows Kolstad, Ulen and Johnson (1990) and makes the Bayesian assumption that the auditor's probability distribution on q_c is truncated at q_s by an assumption that there is zero probability that the legal standard is below q_s. The probability mass below q_s is now distributed above q_s. The conditional probability that the auditor will pay damages if its choice of audit quality is q will be given by:

$$S(q) = R(q)/R(q_s) \tag{7}$$

The auditor's total cost function, equation (3) with this amendment, becomes:

$$TC(q) = C(q) + S(q)\,A(q) \tag{8}$$

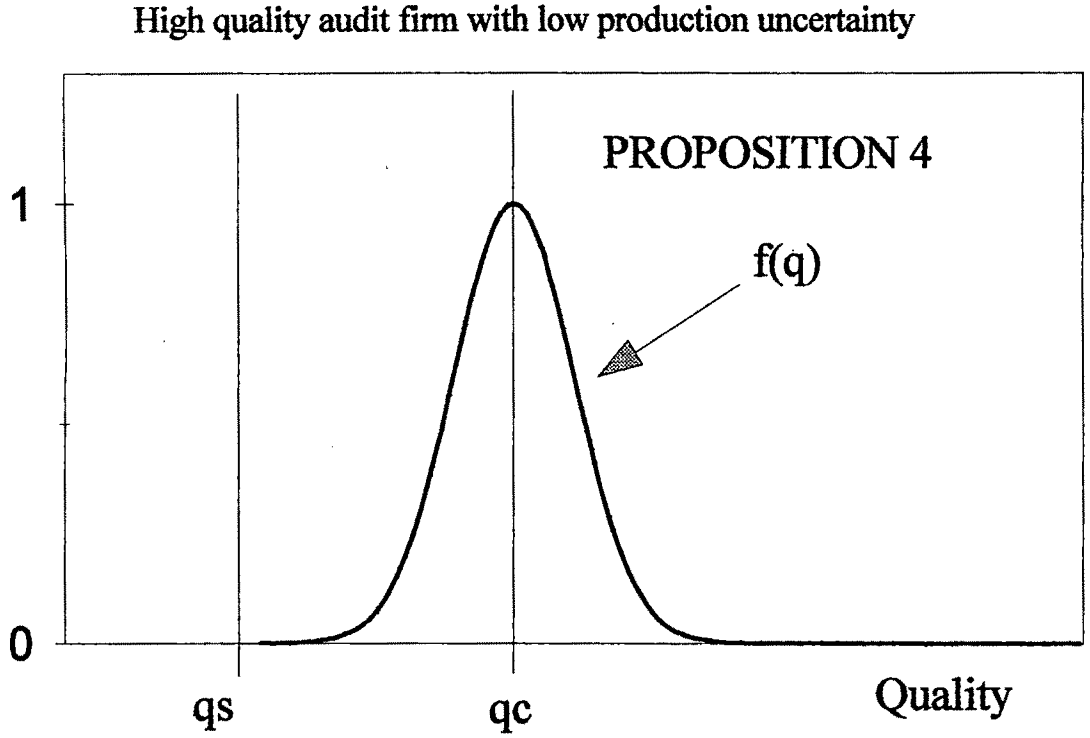
The first order condition for optimality becomes:

$$R(q_s)\,C'(q^{**}) = -R(q^{**})A'(q^{**}) + f(q^{**})\,A(q^{**}) \tag{9}$$

Comparing this result with equation (5) reveals that the effect of an audit standard is captured by the term $R(q_s)$ on the left hand side of equation (9). This is the probability that prior to the imposition of audit standards the auditor believed that the legal standard of care was above q_s.

Proposition 4
Audit standards that are costless to implement are written so that they do not change beliefs about the legal standard of care.

Figure 3(a)
Audit Standards and Production Uncertainty



Proposition 5
Audit standards never reduce the level of audit quality that an auditor will choose.

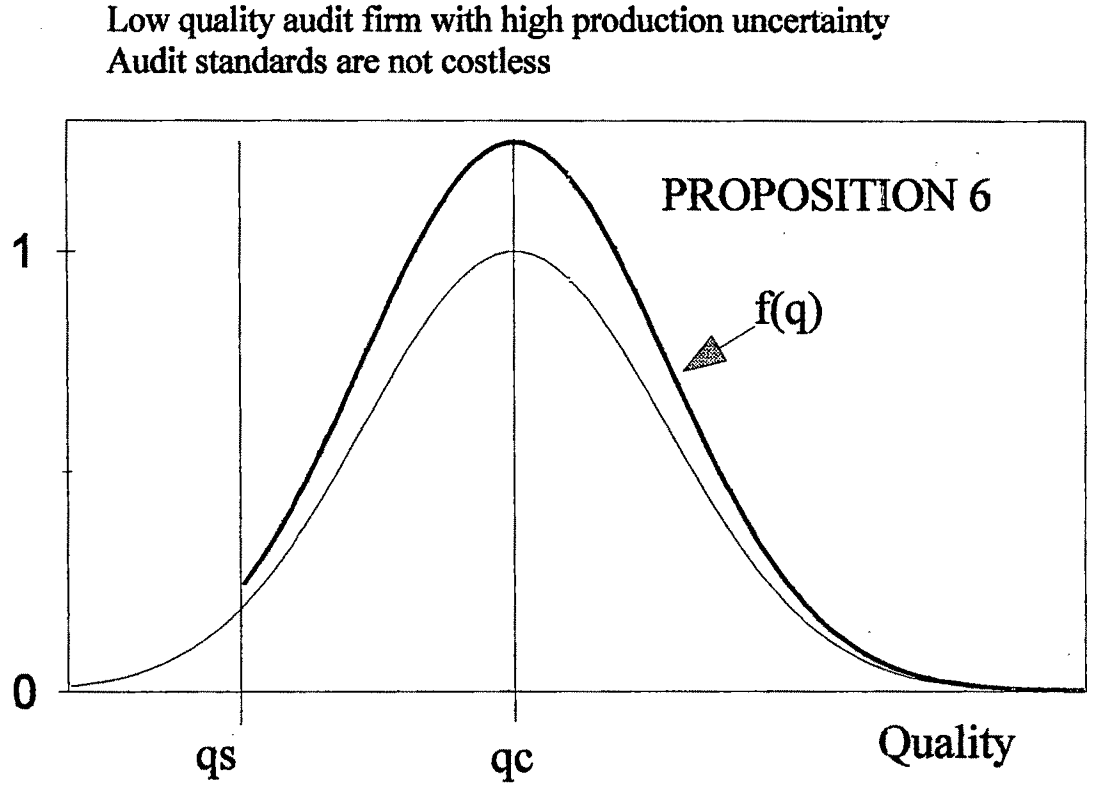
Proposition 6
The nearer the audit standard is to the legal standard, the greater the level of audit quality that the auditor will choose to supply, and the greater the direct costs that they impose on auditors.

Proposition 4 follows from noting that if ex ante standards, q_s, are set at a level such that the auditor was certain before their imposition that the legal standard was higher than $R(q_s) = 1$. Equation (9) simplifies back to become equation (5), the optimal condition in the absence of ex ante standards. Audit standards are then an irrelevance to the choice of audit quality, and would be costless to implement. They would take on the character of a textbook, describing the obvious, without affecting behaviour. An implication of this proposition is that if the law changes, and uncertainty about the legal standard of care is reduced, audit standards once economically significant can become an irrelevance. Audit standard effectiveness cannot be reviewed separately from legal standards.

Proposition 5 develops the analysis of the interaction of ex ante and ex post standards by noting that $R(q_s)$, being a cumulative probability function, is bounded to the range (0, 1). The effect of multiplying $C'(q^{**})$ by $R(q_s)$ in the left hand side of equation (9) is either to leave it unchanged as with proposition 4, or to reduce it. Reducing the effect of the marginal cost increases the optimal level of quality, since the left hand side of equation (9) is a decreasing function of q. It follows for all values of q_s that $dq^{**}/dq_s \geq 0$ and that audit standards never reduce the level of quality chosen. In this sense, increasing audit standards cannot do harm.

Proposition 6 follows from noting that $R(q_s)$ is a decreasing function of q_s. As q_s is increased towards q_c from below, the smaller $R(q_s)$ becomes and the greater the value of q^{**} to satisfy equation (8). For an auditor choosing to produce an audit quality in excess of q_c, the imposition of audit standards causes the optimal choice to be even greater. For an auditor who optimally chose to deliver an audit quality below q_c, either because of the beliefs about what the court might accept as non-negligent work, or because of assessments of the costs, audit standards could have the effect of moving the optimal choice upwards to q_c. Audit standards set close to legal standards would reduce the uncertainty about the negligence rule and would produce an effect similar to proposition 3, making the returns for effort more effective. The

Figure 3(b)
Audit Standards and Production Uncertainty



nearer that the ex ante standard is to the ex post standard, the greater will its impact be in reducing uncertainty about what the auditors can 'get away with', but it also follows that direct costs, C(q), being an increasing function of the supplied quality level, will also increase.

The combination of q_s and q_c, where q_s serves as a lower bound on the uncertainty surrounding q_c, is an effective arrangement from an analytical perspective in changing the auditor's private choice of audit quality. The degree to which q_s approaches q_c is the political choice.

The analysis has modelled the auditor's decision about the level of quality to deliver as it is influenced by uncertainty about negligence. The level of quality produced is a complex function of choices about planning, materiality levels and sample sizes; the training, experience, motivation and ability of audit field staff; time budgets; supervision; the interpretation of evidence and so on. There is uncertainty in the execution of an audit in the production process. The effect of production uncertainty is to alter the probability of being liable at a choice of quality level. That is, delivered audit quality is itself also only revealed ex post, together with the court's judgment about the legal standard of due care. The ex post legal uncertainty faced by an audit partner is a combination of two elements: production uncertainty and negligence uncertainty. If audit firms differ in their ability to manage the audit process—that is, the audit firms themselves are of differing quality[14]—then audit standards will have a differential impact across audit firms.

These considerations are depicted in Figure 3. Figure 3 (a) shows the situation facing a 'high quality' audit firm. This is an organisation that delivers planned audit quality with a high degree of reliability. Accordingly, the uncertainty about the ex post legal liability represented by the subjective probability distribution is mainly due to negligence uncertainty. The ex ante audit standards, q_s, do not influence this subjective probability density function, and the situation described by proposition 4 applies. For the 'high quality' audit firm, audit standards are costless to implement.

Figure 3(b) extends the analysis of the same situation to the perspective of a 'low quality' firm, with a more erratic control over audit production. The subjective probability distribution is more diffuse, since it incorporates more production uncertainty with the negligence uncertainty. The figure depicts the same audit standards intersecting this subjective probability density function. The truncation of f(q) below q_s, and the redistribution of judgment according to equation (7), gives rise to the situation described by proposition 6. For 'low quality' audit firms, audit standards are not a costless irrelevance. The political choices are evident. If ex ante audit standards are set below the lowest common denominator, they command consensus support from auditors. As the level of standards is raised, so costs are first imposed on the lowest quality providers.

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[14] Moizer (1993) provides a review of the empirical evidence which is consistent with the view that audit firms are of different quality. There are a variety of sources, from: (a) regressions of audit fees and audit pricing studies; (b) the behaviour of discounts on initial public offerings; (c) share price reactions to companies switching auditors; (d) litigation rates; and (e) opinion surveys.

Conclusions

A number of propositions about how ex post liability rules and ex ante audit standards interact have been developed. These have highlighted the profound influence that uncertainty about liability rules can have on the quality of audit work. This uncertainty is the explicator of an insurance component in audit fees. A surprising insight is that a large uncertainty about the legal standard of care can reduce rather than increase the quality of audit work supplied, and increase the insurance component. The behaviour in response to an uncertain ex post standard of care can be modified by ex ante standards. Since influence of ex ante standards is indirect, through its effect on ex post liability, it requires a joint analysis. For a self-regulating profession, in order for an audit standard to influence behaviour it must reduce uncertainty about the legal standard of care. An effective combination is for ex ante standards to be set below the ex post standards of care so that they provide a lower bound on acceptable work. Too far below legal standards, audit standards would have no impact as far as operational decisions were concerned, although they would have the benefit of being no imposition and a costless irrelevance. Audit standards would have a differential impact on an audit industry whose firms differ in their ability to manage the production process.

This paper's ambition has been to reveal the purely analytical properties of the technology of regulation. The static trade-offs between legal standards and audit standards have been analysed from the individual auditor's perspective, for whom these are exogenous parameters. For regulators and legislators seeking to influence audit behaviour, the nature of these trade-offs, and the dynamics of their joint interaction, need to be appreciated. The economic analysis applied is itself a technology of simplification, powerful in revealing structure, but subversive in privileging certain assumptions and conjectures, neglecting others.

The major assumptions employed are: risk neutrality; ex ante certain standards; treating quality and negligence as having a single component; a Bayesian revision of beliefs; the view of the court uninfluenced by professional standards other than as a lower bound; neglect of the user's precautionary behaviour; unlimited liability with no bankruptcy; and availability of insurance. These are all refinements that would need to be relaxed for a complete analysis.

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UK Accountants' Perceptions of Research Journal Quality

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Abstract—The process of research quality assessment is now firmly established in UK universities. The quality of the journals in which academic papers are published is an important input to the assessment process. The relative quality of these journals is clearly difficult to establish in an objective manner. This paper contributes to the debate about relative quality by conducting a peer review. Eighty-eight UK accounting academics reported their degree of familiarity with, and perceptions of quality of, a total of 44 journals in the accounting and finance discipline. *Accounting and Business Research* and the *British Accounting Review* were the two most familiar academic journals. The most highly ranked journals were generally from the US.

Introduction

The measurement of research quality is of crucial, and growing importance, in the UK university sector. Individuals and institutions are increasingly being evaluated on the basis of their 'research' output. Promotion within the most prestigious UK universities is contingent upon a good 'research' performance. The funding of universities is now awarded on the basis of Research Assessment Exercises (RAEs), with UK universities being graded on the basis of their perceived research performance. The 1996 RAE places a greater emphasis on research quality, and has a more refined grading system than in previous RAEs.

Despite the growing importance of research quality, the assessment of research remains a subjective and difficult area (see, for example, Humphrey, Moizer and Owen, 1995). Good quality research has been likened to an elephant: 'One knows it when one sees it'. There are few objective criteria. However, publication in quality research journals is generally acknowledged to be a fundamental criterion of any research evaluation (Whittington, 1993). As part of the 1996 RAE, UK academics have been asked to select their 'best' four publications from January 1992 to March 1996. This does, however, raise the questions: what is a research journal; and how does one journal rank against another? This is particularly difficult given the subjective nature of research quality and the different preferences and interests of individual accounting academics.

Peer assessment depends, at least in part, on attitude measurement.[1] Informed individuals are asked their opinion, in this case of accounting and finance journals. The process by which these opinions are formed is likely to be complex. The nature and quality of individual articles within journals will vary, just as the nature and quality of individual journals varies. Attitude measurement attempts, in one score, to capture the 'essence' of a journal through ascertaining respondents' stated perceptions. Moreover, different individuals will have different ideas of research quality based on their research interests, experience and knowledge. Scores awarded by individuals are, therefore, inherently subjective and will be based on a variety of factors such as the individual's experience. Given the lack of other objective and reliable measurement techniques however, we consider that peer measurement does provide a useful insight into journal quality.[2]

This research study, which is based on a survey of UK academics in 1993 in the accounting and finance domain, attempts to throw some light on

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[1] An attitude is an organised predisposition to think, feel, perceive and behave toward a referent or cognitive object (Kerlinger, 1973, p. 495). Attitude measurement has commonly been used in accounting to measure the perceptions of individuals.

[2] Citation analyses are sometimes argued to be more objective than opinion surveys. However, they have weaknesses of their own, Many accounting journals are not included in the social citations index (Brown and Huefner, 1994). In addition, citation studies have been criticised for lacking uniformity and for being biased (Over, 1978). Furthermore, Porter (1976) compared two psychology-focused citation measures, finding considerable differences.

these questions. Hopefully, those wishing to make assessments of accounting journal quality will be supplied with a benchmark criterion of peer assessment. Those who studied the 1992 RAE have indeed concluded that information on journal quality is badly needed (Taylor, 1994). There is already an informal network of information supplied by individual faculties;[3] however, this study provides much more comprehensive and systematic peer review information. This research is based on publications recorded in the British Accounting Research Register (BARR) in 1990 and 1991, the latest data available at the time of the study, and does not directly relate to the period covered by the latest RAE. However, given the long lead time in which attitudes to journals change, we believe this study is still pertinent to the 1996 RAE and any subsequent RAEs.

As the main aim of this study was to assess perceptions of research journal quality, and the focus was solely on research journals, we surveyed only active researchers. This distinguishes our study from earlier studies (Benjamin and Brenner, 1974; Howard and Nikolai, 1983; Nobes, 1985, 1986; Hull and Wright, 1990; Brown and Huefner, 1994). The previous studies all surveyed both refereed and non-refereed (professional) journals.[4] The present study focuses not only on research journals, but also (unlike previous studies) concentrates principally on journals in the accounting and finance discipline, thus excluding journals such as *Journal of Business*, which are not mainstream outlets for accounting academics. Despite this narrower focus, 44 journals were surveyed. This confirms Zeff's (1988) observation that there has been an explosion of academic accounting journals in recent years.

The remainder of this article consists of three sections, followed by a conclusion and implications. The following section reviews the relevant previous research, focusing, in particular, on the findings in relation to research journals. In the next section, the study's methodology is presented. The main results are then outlined and discussed.

Prior literature

The key features of five previous studies (Benjamin and Brenner, 1974; Howard and Nikolai, 1983; Nobes, 1985, 1986; Hull and Wright, 1990; and Brown and Huefner, 1994) into the perceptions of journal quality are summarised in Table 1.[5] We do not formally survey articles concerning institutional publication output (for example, Lyall, 1978; Gray, Haslam and Prodhan, 1987; Gee and Gray, 1989; Hutchinson, 1989; and Gray and Helliar, 1994). Benjamin and Brenner's (1974) study, based on 82 US accounting faculty and 60 departmental heads, elicited opinions on 24 accounting and business related journals. Benjamin and Brenner found the *Journal of Accounting Research* and *The Accounting Review* to be the top accounting journals. The Benjamin and Brenner study differed from the four later studies, principally in terms of the smaller range of journals surveyed, only 24, as against 51 for both Howard and Nikolai (1983) and Nobes (1985, 1986), 79 for Hull and Wright (1990), and 44 for Brown and Huefner (1994). Benjamin and Brenner, like Brown and Huefner (1994), used a five category Likert-style questionnaire, with 1 and 5 representing poor and excellent quality, respectively. The other three studies all used the magnitude estimation method of attitude measurement.

The magnitude estimation method, which enables relative judgments of value to be expressed at the ratio level, focuses on the intensity of attitude. In this method, a benchmark journal is established and then academic accountants express their relative opinions of other journals. Howard argues that magnitude estimation is superior to partition measures (such as the Likert scale) as it 'yields information about the issue rather than the subject and also focuses on the intensity of attitude rather than the degree of discrimination' (1981, p. 620). Academics are able to give a range of values to the journals, reflecting the strength of their opinions about individual journals. Howard and Nikolai (1983) and Hull and Wright (1990) used the *Journal of Accountancy* as their benchmark accounting journal, while Nobes (1985) chose *The Accounting Review*. In each case, the benchmark journal was awarded 100. The distribution of journal scores is much wider and less skewed when the *Journal of Accountancy*, rather than *The Accounting Review*, is the benchmark journal. For example, in Nobes' (1985) study the spread of mean scores is from 23 to 104, with *The Acounting Review* ranking third out of 37. However, in Howard and Nikolai's (1983) study, the range is from 24.18 to 176.70, with the *Journal of Accountancy* ranking 13th out of 51. Finally, in Hull and Wright's (1990) study, the scores ranged from 33.62 to 274.52, with the *Journal of Accountancy* ranking 42nd out of 79.[6]

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[3] For example, the Lancaster University Management School 1994 Listing and the Judge Institute of Management Studies Quality Ranking of Journals in Management and Social Science (1994). Both of these are primarily internal documents. However, because of the paucity of comparative information in this area, they have been widely circulated. Such partial studies may be misleading, especially in accounting, which is not an established academic discipline at Cambridge.

[4] Typically, accounting research journals are refereed either by the editor or by independent peer reviews. Some non-research journals, such as *Journal of Accountancy*, are also refereed, but as they are professional rather than research journals, we did not survey them.

[5] We have not discussed Raabe, Kozub and Sanders' (1987) review of US tax accounting faculty publication outlets for two reasons. First, these authors survey a 'comprehensive universe of tax journals' (p. 45), many of which are unknown in the UK. Second, they do not evaluate many mainstream accounting journals. We have excluded Coe and Weinstock (1983) for similar reasons. Coe and Weinstock survey 14 journals, but only three (*The Accounting Review*, *Journal of Accounting Research* and the *Journal of Finance*) were scored by 10 or more of this study's respondents.

Another important differentiating factor in Nobes' research is that it was based on academics in Australia, New Zealand and the UK. The journal list was reoriented to accommodate this. Generally, however, Nobes found a considerable degree of correlation between Howard and Nikolai's (1983) study and his own results. He did, however, (perhaps unsurprisingly) find that, 'non-US academics regard non-US journals more highly than US academics' (Nobes, 1985, p. 703).

Brown and Huefner's (1994) research into the views of senior accounting faculty in 40 leading US MBA programmes is the most recent research to be published in this area. Forty-four journals were selected that would 'be reasonably likely outlets for the research of US accounting academics' (p. 227). These journals included academic and professional journals and were ranked by 181 US academics on a five-point Likert scale from 1 (most prestigious journals) to 5 (insignificant journals). Brown and Huefner's list was not comprehensive, excluding, for example, *Accounting, Auditing and Accountability Journal.*

The two main aspects of their study were familiarity and journal quality. The five most well-known journals in rank order were *The Accounting Review, Journal of Accountancy, Journal of Accounting Research* equal with *Accounting Horizons* and *Journal of Accounting and Economics*. In terms of composite quality score, the most prestigious journal was *The Accounting Review* with a score of 1.07, the least prestigious was *EDP Auditor* with 3.64. The rankings for sub-groups (financial, managerial, auditing and tax faculties) all closely paralleled the full rankings. Importantly, however, Brown and Huefner point out that they have 'no evidence that their results are representative of accounting academics employed at non-US universities' (p. 245).

Overall, as Table 1 demonstrates, considerable uniformity exists in the ranking of the premier quality research journals across all the studies. *Accounting, Organizations and Society, The Accounting Review, Journal of Accounting Research, Journal of Accounting and Economics, Journal of Finance* and *Journal of Financial and Quantitative Research* dominate the first five rankings. In addition, Brown and Huefner in the most recent study (published in *Contemporary Accounting Research*) find *Contemporary Accounting Research* to be in the top five. With the exception of *Accounting, Organizations and Society*, all are North American journals, which focus on empirical and statistically-based research.

Our particular replication study was motivated by the need to update the previous research, particularly in the UK context. This has become more urgent given the rapid introduction of new academic refereed journals, and the increasing pressure to publish high quality research in the accounting discipline. Consequently, the main objective of this current study is to measure all academic, refereed journals in the mainstream accounting and finance area in which UK academics have published, or might be likely to publish.

Method

Forty-nine journals were selected after a review of the previous literature, a pilot study and an examination of the BARR's accounting and finance publications. The list of journals surveyed included 'theoretical' and 'application' oriented journals, covering both general and specialised areas (for example, accounting history, accounting education and auditing). Any journal currently published was included. This was at variance with the method used in Howard and Nikolai (1983) and Hull and Wright (1990), who only included journals that had been published for three years. However, although all journals, irrespective of date of first issue, have been included in this study, we recognise that quality judgments for relatively new journals are less robust than for well established journals. Journals in existence for less than three years from the time the survey was undertaken have therefore been excluded from the overall analysis of assessments of quality in Table 4A, and are reported separately in Table 4B.

The population of our survey comprised all UK academics identified from the 1992 BARR as being 'active' researchers. We defined active primarily as all accounting academics who had published at least one research/academic article in the period covered by BARR, i.e., 1990 and 1991. We also included all professors, even if they had not published a research/academic article in this period, on the grounds that their professorship was likely to have been awarded on the strength of a sound research profile and a good knowledge of academic journals. A total of 260 academics (including 94 professors) from the British and Irish institutions represented in the BARR satisfied the criteria for inclusion in the survey. Of these, 241 were from 'old' universities and 19 were from 'new' universities.

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[6] Given this spread of marks and the different journal benchmark scores, absolute companions of scores become meaningless. Rank comparisons are consequently preferred in this paper.

Table 1
Analysis of Prior Accounting Academic Perceptions Literature

Study	*Academics surveyed*	*Range of journals surveyed*	*Sampling methodology and size*	*Methodology*	*Top five journals common to original and present study**
Benjamin and Brenner (1974)	Accounting faculty members and department heads of the 163 schools of business accredited by the American Association of Collegiate Schools of Business.	24 accounting and business related journals. Refereed and non-refereed.	Random 200. 82 faculty members and 60 department heads responded.	5-scale Likert.	1. *Journal of Accounting Research (1)* 2. *Accounting Review (2)* 3. *Abacus (7)* 4. *Financial Analysts Journal (8)* 5. *Journal of Taxation (9)*
Howard and Nikolai (1983)	All accounting educators published in Hasselbach (1980-81) with an earned doctorate and teaching at a US institution.	51'conceptual' and 'application' accounting oriented journals. Refereed and non-refereed.	Random 25% (adjusted for errors in listing). 311 out of 528 usable responses (58.9%).	Magnitude estimation using *Journal of Accountancy* as the benchmark 100.	1. *Journal of Accounting Research (1)* 2. *Accounting Review (2)* 3. *Journal of Finance (3)* 4. *Journal of Financial and Quantitative Analysis (4)* 5. *Accounting Organizations and Society (9)*
Nobes (1985; 1986)	All full-time faculty in permanent posts in universities in Australia, New Zealand and UK	37 journals. Generally the top journals from Howard and Nikolai (1983) and 14 additional journals. Refereed and non-refereed.	232 usable responses (41%)	Magnitude estimation using *Accounting Review* as the benchmark 100.	1. *Journal of Finance* 2. *Journal of Accounting Research* 3. *Accounting Review* 4. *Journal of Financial and Quantitative Analysis* 5. *Journal of Accounting and Economics*
Brown and Huefner (1994)	All associate and full professors at the 'best 40' MBA programmes in leading US business schools as identified by *Business Week*, 1991 edition.	44 journals. 31 active journals from *Accounting Literature Index* (1992) and a further 13 judged to be 'appropriate'.	All 367 faculty surveyed, with 181 usable responses (49.3% response rate).	5-scale Likert	1. *Accounting Review* 2. *Journal of Accounting Research* 3. *Journal of Accounting and Economics* 4. *Contemporary Accounting Research* 5. *Accounting, Organizations and Society*
Hull and Wright (1990)	All faculty with an earned doctorate or LLM and teaching at a US institution	50 of Howard and Nikolai's (1983) 51 journals. Another 29 journals added, refereed and non-refereed.	Systematic selection 783 (25%) selected. Overall a 36% response rate (278 replies).	Magnitude estimation using *Journal of Accountancy* as the benchmark 100.	1. *Journal of Accounting Research* 2. *Accounting Review* 3. *Journal of Finance* 4. *Journal of Accounting and Economics* 5. *Journal of Financial and Quantitative Analysis*

*The two earliest studies (Benjamin and Brenner, 1974; Howard and Nikolai, 1983) were conducted on many journals that did not feature in the present study. For these studies we have listed the first five of the journals that we also surveyed, with the rankings of these journals in the originating studies being shown in brackets.

The questionnaires were mailed over the summer of 1993 and a total of 90 responses were received (response rate 34.6%), of which two were unusable, resulting in 88 usable responses (a usable response rate of 33.8%). Of the usable responses, 38 were from professors, two from readers, one from a principal lecturer ('new' university), 21 from senior lecturers (two from 'new' universities, 19 from 'old' universities) and 26 from lecturers. This means that 40% of the 94 professors included in the sample responded. More importantly, when combined with the two readers and 19 'old' university senior lecturers, a total of 59 (or 67% of our sample) were 'senior' staff whose 'seniority' would be likely to reflect an active research profile and a good awareness of academic accounting journals.

Other background information given by the respondents reveals that 94% were from 'old' universities, 89% were male, 65% had a professional accounting qualification, and 37% had a PhD. Of the 86 respondents who gave their age and length of service, 72% were over 40 (with 55% being between 40 and 49) and 72% had over 10 years service. Finally, the respondents were asked to indicate how they rated themselves as a researcher, ranging from 1 (not at all active) to 5 (very active). The results showed that 47% ranked themselves as very active, with a further 37% ranking themselves at point 4 on the scale.[7] None of the respondents ranked themselves as 'not at all active' (point 1), which, given the criteria for selecting the sample frame, was not surprising.

The questionnaire was designed to elicit the respondents' degree of familiarity with the journals they were rating, and their personal assessment of the academic quality of each of 49 academic journals. The degrees of familiarity ranged from 1 (not at all familiar) through 2 (slight), 3 (fair), 4 (quite) and 5 (very). The method adopted for assessing academic quality followed that used in Howard and Nikolai (1983), Hull and Wright (1990) and Nobes (1985; 1986), employing a scale that started at zero but had no upper limit. On this scale *Accounting and Business Research* (ABR) was awarded 100 and the respondents were then asked to award a score to each of the remaining 48 journals that reflected the respondents' personal assessment of each particular journal's academic quality relative to that of ABR. However, if respondents felt that their degree of familiarity with a specific journal was 1 (i.e., not at all familiar) they were asked not to score that journal. For this reason, and also because some respondents chose not to score some of the journals (presumably the ones that were unfamiliar to them), the number of quality assessment scores for each journal varied. The five journals (*Journal of Multinational Financial Management*, *Journal of Taxation*, *National Tax Journal*, *Research in Accounting Regulation*, and *Review of Quantitative Finance and Accounting*)[8] that received 10 or fewer quality assessment scores were excluded from the analysis and do not feature in the tables that follow. (The appendix provides a list of journal titles and abbreviations used.)

Results

The respondents' degree of familiarity with the journals is reported in Table 2, and their assessments of quality are reported in Tables 4A and 4B.[9] Table 3 provides an indication of the respondents' degree of involvement with each journal by reporting the numbers who served (or had served) as 'journal editors'[10], were editorial board members, had published in the journal and had refereed for the journal.

In Tables 2, 4A and 4B, the overall responses are reported and then partitioned into senior/non-senior categories and editorial involvement/non-editorial involvement categories. For this purpose, senior staff are professors, readers and senior lecturers and non-senior staff are lecturers. The impact of seniority was felt to be important because the promotion system in British universities has tended to be heavily influenced by research output. A priori, senior staff are likely to have a greater degree of familiarity with journals and different perceptions of journal quality than non-senior staff. Similarly, those respondents with a major editorial involvement with journals might be expected to have a different level of familiarity and different perceptions of quality from those with no such involvement. For this purpose those respondents who were either journal editors or served on three or more editorial boards were considered to have a major editorial involvement.[11]

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[7] These self-rankings are to some extent confirmed by the respondents' publication profile. The correlation between self-rank as a researcher and number of journals in which they published was highly significant (i.e., at the 1% level). In other words, those who ranked themselves highly as researchers tended to publish in more journals. Although this does not directly indicate the volume (or quality) of their publications, it provides some surrogacy for these indicators.

[8] These five journals received the following responses (R), mean quality score (MQS) and mean familiarity scores (MFS): *Journal of Multinational Financial Management* (R = 5, MQS = 121, MFS = 3.4); *Journal of Taxation* (R = 9, MQS = 80, MFS = 2.67); *National Tax Journal* (R = 7, MQS = 117.14, MFS = 2.57); *Research in Accounting Regulation* (R = 6, MQS = 100.8, MFS = 3.0); and *Review of Quantitative Finance and Accounting* (R = 6, MQS = 121, MFS = 2.33).

[9] These results are, of course, aggregate results. Individual experience varies, and some of these aggregate results may well conflict or appear to be counter-intuitive from the individual reader's perspective.

[10] The expression 'journal editors' includes the following categories of editorial involvement: editor; deputy editor; assistant editor; and associate editor.

Degree of Familiarity

The 'overall' column of Table 2 reveals that five of the six most familiar journals were British, which is unsurprising given the sample frame. *The Accounting Review*, the non-British journal, is interestingly not only one of the most prestigious of the accounting journals, but is also one of the longest established.

The expected higher degree of familiarity of 'senior' respondents is, for the most part, supported by the results in Table 2. A higher degree of familiarity was indicated by senior staff for 27 out of the 44 journals included. However, the Mann-Whitney-Wilcoxon rank test revealed no significant differences between the ranking of the mean familiarity scores of senior and non-senior categories of respondent. The extent to which the differences between the familiarity scores of each journal were significant was tested by the chi-square test as well as the two-tailed t-test for differences between means and ANOVA. Although the chi-square test revealed no significant differences, the t-test and ANOVA did indicate that, for a number of journals, senior respondents' mean familiarity score was significantly different from their non-senior counterparts. As the t-test and ANOVA tests produced virtually identical results, it is the t-test results that are reported in Table 2. From this it can be seen that senior respondents were significantly more familiar with the following journals: *Journal of Business Finance and Accounting*; *The Accounting Review*; *Journal of Accounting Research*; *Journal of Accounting and Economics*; *Research in Third World Accounting*; *Journal of International Financial Management and Accounting*; and *Australian Accounting Review*. Only in the case of *Public Money and Management* were lecturers significantly more familiar with the journal than professors/readers/senior lecturers. These results provide some support, albeit fairly weak, for the view that seniority does have an impact on familiarity with journals.

When the mean familiarity scores are analysed by respondents' editorial involvement, it can be seen that a majority of the journals (25 out of 43) were more familiar to those with major editorial involvement. Once again, no significant differences were found between the rankings of the two categories' mean familiarity scores (using Mann-Whitney), and the chi-square test revealed no significant differences for individual journals. The t-test and ANOVA produced fewer examples of journals being significantly more familiar. In fact, as can be seen from the t-test statistics reported in Table 2, three of the 'finance' journals (*Journal of Finance*, *Journal of Financial and Quantitative Analysis* and the *Financial Analysts Journal*) appear to be significantly more familiar to those respondents without major editorial involvement. However, with only five significant between the mean differences across 44 journals, our results would seem to indicate that the presence or absence of major editorial involvement has little discernible impact on the degree of familiarity with journals.

Degree of Involvement with Journal

The journals in Table 3 are arranged in descending order by the number of respondents *publishing* in the journal. Thus 26 of our respondents have published in *BAR*, three served (or had served) as a journal editor, 13 have served on the editorial board and 31 have refereed for the journal. Not surprisingly, most of the publishing and refereeing activity and most of the editorial involvement is with British journals. Out of the 190 cases where our respondents had published in journals, 101 (53%) were in the top six journals in Table 3 (*British Accounting Review*, *Accounting and Business Research*, *Journal of Business Finance and Accounting*. *Accounting, Auditing and Accountability Journal*, *Management Accounting Research* and *Accounting, Organizations and Society*). Of the 10 journals with the highest editorial involvement by British academics, only two, *Accounting, Auditing and Accountability Journal* and the *European Accounting Review*, are not British. British academics almost exclusively provide editorial support for, and publish in, British journals.

For the four journals (all US) that received the highest overall mean quality score (see Table 4A), there was no involvement in any of the categories shown in Table 3 by any of our respondents. One can speculate that this may result from networking (i.e., British academics network with mainly British academics), or content (British journals will be principally interested in research that is based on British data). One would also expect similar pressures to influence US academics' publishing patterns. Alternatively, if one was provocative, one could argue that British academics are simply not good enough to publish in US journals, or perhaps *perceive* they are not good enough, and thus do not submit to US journals.

These findings from accounting are borne out more generally by Doyle and Arthurs' (1995) research into the publication pattern of British busi-

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[11] We chose this level of editorial involvement as it constituted approximately 20% of our sample. The 18 academics represented 12 journal editors plus six non-editors who served on three or more editorial boards. Journal editors plus two or more editorial boards and journal editors plus four or more editorial boards totalled, respectively, 30% (26 individuals) and 15% (13 individuals) of our sample. In our opinion, the former selection was not an 'elite' sample, while the smallness of the latter selection would have impeded statistical testing.

Table 2
Degree of Familiarity with Journals

	Overall	*Seniority of staff*		*Editors/ editorial board*	
Journal	*Sample*	*Prof/SL*	*Lect*	*Yes*	*No*
ABR	4.48	4.51	4.47	4.76	4.44
BAR	4.44	4.47	4.43	4.45	4.44
JBFA	4.00	4.11	3.77*	3.95	4.01
Accounting Review	3.90	4.11	3.50**	4.29	3.81*
AOS	3.89	3.94	3.99	3.98	3.86
Fin Acc & Man	3.60	3.67	3.41	3.68	3.58
Journal of Finance	3.54	3.54	3.44	3.01	3.67*
J of Acc Res	3.51	3.81	3.00***	3.68	3.46
Acc Horizons	3.50	3.62	3.30	3.52	3.50
J of Fin & Quant Analysis	3.46	3.43	3.53	2.55	3.74***
AAAJ	3.36	3.51	3.03	3.53	3.30
Crit Persp on Acc	3.33	3.36	3.25	3.40	3.30
Fin Analysts Journal	3.32	3.21	3.80	2.38	3.59***
J of Acc & Econ	3.30	3.45	2.87*	3.15	3.34
Res in Third World Acc	3.29	3.49	2.29**	3.61	3.08
J of Man Acc Res	3.29	3.32	3.21	3.53	3.21
Man Acc Res	3.27	3.23	3.29	3.15	3.30
European Accounting Review	3.18	3.14	3.30	3.43	3.10
J of Acc Lit	3.12	3.12	3.05	2.87	3.22
Abacus	3.08	3.17	2.97	3.18	3.05
Int Journal of Acc	3.07	2.94	3.38	2.92	3.14
Public Money & Man	3.06	2.89	3.58*	2.93	3.09
Issues in Acc Ed	3.01	2.89	3.33	2.56	3.19**
Business History	2.99	2.97	3.11	3.08	2.97
J of Acc & Pub Policy	2.98	3.02	2.84	2.99	2.97
J of Acc Aud & Fin	2.97	2.98	3.15	3.26	2.90
Accounting Education	2.94	2.96	2.91	2.70	3.02
J of Int Fin Mgt & Acc	2.90	3.08	2.21**	3.59	2.72
J of Cost Man	2.90	3.05	2.00	3.64	2.61
Adv in Pub Int Acc	2.89	2.87	2.99	3.14	2.82
Australian Acc Review	2.89	3.43	2.45**	—	2.90
Cont Acc Res	2.87	2.84	2.80	2.77	2.91
Auditing - Pr & Theory	2.87	2.68	3.28	2.75	2.92
J of Acc Ed	2.80	2.65	3.07	2.87	2.78
Int J of Acc Aud & Tax	2.78	2.74	3.00	2.00	3.00
Managerial Finance	2.75	2.73	3.13	2.86	2.72
Acc Bus & Fin Hist	2.72	2.67	2.81	2.48	2.79
Acc Hist Journal	2.68	2.80	2.40	2.55	2.73
British Tax Review	2.66	2.55	2.83	2.00	2.76
Pacific Acc Review	2.65	2.70	2.00	3.11	2.53
Adv in Int Acc	2.61	2.71	2.00	2.71	2.51
Behav Res in Acc	2.56	2.81	2.00	3.08	2.31
Adv in Accounting	2.56	2.60	2.00	2.86	2.45
Acc & Finance	2.55	2.64	2.37	2.26	2.66

Note: Geometric means are presented in this table to ensure consistency with Tables 4A and 4B (see also Table 4A, Note 2). The journal rankings remain substantially the same whether based on arithmetic or geometric means. The starred journals in the 'Seniority of Staff' column are those whose mean degree of familiarity scores given by professors/readers/senior lecturers are significantly different (using the t-test based on the arithmetic mean) from the mean degree of familiarity scores given by lecturers. The starred journals in the 'Editors/editorial board' column are those whose mean degree of familiarity scores given by editors and/or those serving on three or more editorial boards are significantly different (using the t-test based on the arithmetic mean) from the mean degree of familiarity scores given by those who were not editors and did not serve on three or more editorial boards.

In all cases the significance level is indicated as follows
* Significant at 10% level
**Significant at 5% level
***Significant at 1% level

Table 3
Degree of Involvement with Journal

Journal	*Published in journal*	*Journal editor**	*Member of editorial board*	*Refereed for journal*	*Book review for journal*
BAR (UK)	26	3	13	31	18
ABR (UK)	23	2	5	31	17
JBFA (UK)	17	1	3	24	1
AAAJ (AUS)	13	—	8	13	4
Man Acc Res (UK)	12	2	—	12	—
AOS (UK)	10	—	4	15	—
Fin Acc & Man (UK)	9	1	2	7	—
Accounting Education (UK)	8	1	5	10	5
European Accounting Review (DEN)	8	1	2	8	1
Res in Third World Acc (UK)	8	2	2	2	—
Crit Persp on Acc (CAN/US)	8	1	2	11	—
Abacus (AUS)	8	—	—	7	1
Int Journal of Acc (US)	6	—	—	1	—
Adv in Pub Int Acc (US)	5	—	1	1	—
Acc Bus & Fin Hist (UK)	5	1	1	7	3
J of Acc & Pub Policy (US)	3	—	2	2	—
Managerial Finance (UK)	3	—	1	1	—
Public Money & Man (UK)	3	—	—	1	—
Acc Hist Journal (US)	2	—	1	3	1
J of Int Fin Mgt & Acc (US)	2	—	1	2	—
J of Cost Man (US)	2	—	—	—	—
J of Man Acc Res (US)	2	—	—	2	—
Business History (UK)	2	—	—	1	1
Accounting Review (US)	1	—	1	3	1
Int J of Acc Aud & Tax (US)	1	—	1	2	—
Pacific Acc Review (AUS)	1	—	1	1	—
Adv in Accounting (US)	1	—	—	—	—
Acc Horizons (US)	1	—	—	2	—
Behav Res in Acc (US)	—	—	1	1	—
Cont Acc Res (CAN)	—	—	—	1	—

*The expression 'journal editor' includes the following categories of editorial involvement: editor; deputy editor; assistant editor; and associate editor.

ness school academics. Using a centrality index of 82 journals based on the 1991 journal citation reports, they derive the 20 most influential journals from the perspective of impact on the business and management studies discipline. In these journals, they find 'a surprisingly small presence, even from those [UK] business schools classified as "internationally excellent" ' (p. 257).

Doyle and Arthurs speculate on their results, wondering whether their citation method was flawed, whether UK academics produce work of equal or greater worth than Americans but do not wish to be forced into the dominant American mould, and whether the British are simply insular publishers. Curiously, Doyle and Arthurs do not advance either the 'networking' or the 'content' arguments we discuss above. However, whatever the reason, as Doyle and Arthurs (1995) point out, this publication pattern is typical of British business school academics generally, and not just accounting academics.

Quality Assessment Scores

Tables 4A and 4B report the assessment of quality scores given to each journal by the respondents using the geometric mean of the individual scores. This is consistent with earlier research (see, for example, Howard and Nikolai, 1983). Geometric means are computed by multiplying together the

Table 4A
Assessment of Quality of Established Journals

	Overall		Seniority				Editors/editorial board			
			Professor/ Senior lecturer		Lecturer		Yes		No	
Journal	*n*	*Score*	*n*	*Score*	*n*	*Score*	*n*	*Score*	*n*	*Score*
Journal of Finance	54	179.6***	41	180.0**	12	175.2	10	143.4	44	189.0***
J of Fin & Quant Analysis	44	175.9**	35	167.1*	8	228.4	9	136.4	35	187.8*
J of Acc & Econ	64	147.8*	45	151.7	18	135.6	15	117.1	49	158.8*
J of Acc Res	77	137.9*	50	147.9	25	120.9	17	107.6	60	147.9
Accounting Review	83	130.1**	56	134.4	26	121.3	18	113.1	65	135.9**
AOS	79	126.1***	53	127.1***	24	127.7	18	134.3	61	123.8
Cont Acc Res	29	108.6	22	110.4	6	99.8	8	119.1	21	104.8
J of Acc & Pub Policy	47	106.1*	35	106.0	12	106.3**	14	107.7	33	105.4**
J of Int Fin Mgt & Acc	22	104.5	18	104.4	4	105.0	5	103.7	17	104.7
JBFA	83	102.9**	55	106.3	26	95.5**	18	98.5	65	104.1**
ABR	88	100.0	58	100.0	28	100.0	18	100.0	70	100.0
J. of Acc Aud & Fin	34	98.8	27	100.1	6	93.3	7	110.4	27	96.0*
J of Acc Lit	45	98.8	35	95.2	9	115.4	12	97.7	33	99.2
J of Man Acc Res	39	98.4*	29	99.9**	10	94.4	10	94.6	29	99.7**
Auditing - Pr & Theory	31	97.6	20	97.1	11	98.6	7	102.2	24	96.3**
Crit Persp on Acc	66	95.1*	46	93.2	20	99.6	17	101.3	49	93.1*
Fin Acc & Man	58	91.5	43	90.9	15	93.5	15	91.7	43	91.5
Man Acc Research	59	90.6**	42	91.8**	16	87.3	12	92.7	47	90.1**
Fin Analysts Journal	37	90.5	30	92.6**	6	96.9	7	87.5	30	91.2
Behav Res in Acc	22	90.1*	16	97.2*	6	73.5	8	98.7	14	85.5
Abacus	75	89.5	49	92.6	25	83.4***	18	98.5	57	86.8
Business History	17	88.1	14	86.8	3	94.4	4	100.0	13	84.7
Adv in Accounting	17	87.5	16	88.0	1	80.0	5	99.6	12	83.0
Adv in Pub Int Acc	24	87.3	19	87.7	5	85.9	6	96.5	18	84.5
J of Cost Man	16	85.0	14	84.4	2	89.4	5	72.4	11	91.4
AAAJ	69	84.4***	48	88.9**	21	75.0***	17	87.6*	52	83.4***
Acc Hist Journal	33	82.6	23	86.3	10	74.8**	10	88.1**	23	80.3**
BAR	84	82.2	55	78.5	27	89.9	18	83.9*	66	81.7*
Int Journal of Acc	43	81.7	29	84.7**	14	75.8	13	86.6	30	79.6
Acc Horizons	64	81.0	42	81.5	22	80.1	17	92.1	47	77.4*
J of Acc Ed	32	80.9	20	80.4	12	81.7	7	90.8	25	78.3
Issues in Acc Ed	54	80.8	35	79.5	18	84.2	14	72.2	40	84.0
Adv in Int Acc	15	80.2	13	83.3	2	63.3	7	83.3	8	77.7
Int J of Acc Aud & Tax	11	80.1**	9	80.2	2	80.0*	2	77.5	9	80.8
British Tax Review	26	77.1	15	77.7***	11	76.2	3	78.1	23	77.0
Pacific Acc Review	14	75.1	13	75.5	1	70.0	3	76.5	11	74.8
Acc & Finance	34	74.1	23	75.1	11	71.9	9	71.3	25	75.1
Public Money & Man	34	73.7**	25	72.4	9	77.1*	5	66.1	29	75.0
Managerial Finance	40	68.7	34	69.3	5	79.0	10	68.1	30	68.9

Notes 1. The starred journals are those whose quality scores are significantly correlated with degree of familiarity. The significance level is indicated as follows:
* Significant at 10% level
** Significant at 5% level
*** Significant at 1% level

2. All respondents did not fully complete the personal information section of the questionnaire. The number of responses by sub-category will therefore not always total the overall number of responses for each journal. The geometric mean presented in this table is very sensitive to differential response rates. This is why in some cases (such as *AOS*) the overall score is not easily reconcilable to the partitioned scores.

Table 4B
Assessment of Quality of Recently Established Journals

	Overall		*Seniority*				*Editors/editorial board*			
			Professor/ Senior lecturer		*Lecturer*		*Yes*		*No*	
Journal	*n*	*Score*	*n*	*Score*	*n*	*Score*	*n*	*Score*	*n*	*Score*
Acc Bus & Fin Hist	37	81.9	24	85.6	13	75.4	8	90.0	29	79.8
Australian Acc Review	12	81.5	6	77.4	6	85.9	—	—	12	81.5
Res in Third World Acc	19	79.6	16	79.9	3	78.3	7	79.4	12	79.8
European Accounting Review	68	78.0	48	76.0	19	87.7	17	77.5	51	78.3
Accounting Education	58	68.1**	37	69.4**	21	65.8	13	71.3	45	67.2**

Note: See Table 4A

individual scores given to each journal and then taking the n^th^ root (where n equals the number of respondents for that journal) of the product. One effect of the geometric mean is to reduce the impact of outliers; this was seen as particularly important for this study because three of the respondents scored some journals (mainly finance journals) substantially higher than the remainder of the respondents. An analysis of the data, after excluding these outliers, revealed only a marginal impact on the overall results. Our analysis, therefore, includes the three outliers.

As can be seen from Table 4A, the three highest ranked journals are all finance journals. Of the accounting journals, *Journal of Accounting Research, The Accounting Review* and *Accounting Organizations and Society* are clearly regarded as of much higher quality than the remainder, with a large gap between these and the next group of journals, led by *Contemporary Accounting Research* at 108.6. *Contemporary Accounting Research*'s position is surprising given that its degree of familiarity ranking (2.87), as reported in Table 2, is relatively low. Only 29 respondents scored this particular journal, and presumably its reputation, rather than the respondents' knowledge of it, must have influenced the assessment of its quality.

The general relationship between the overall degree of familiarity reported in Table 2, and the overall assessment of quality reported in Tables 4A and 4B, was determined by calculating the correlation coefficient between familiarity scores of 3 or more on the 5-point familiarity scale, and quality assessment. The significant relationships are indicated in Tables 4A and 4B through the use of asterisks. For the overall sample the correlation coefficients were significant for 16 journals, and for all but one of these the relationship was positive (i.e., the higher the familiarity, the higher the journal quality rating). In general, the higher-ranked rather than the lower-ranked journals were correlated. This may perhaps reflect the fact that higher-ranked journals have a more established and accepted pecking order than more lowly-ranked journals. Moreover, eight of the top 10 journals in terms of overall quality assessment, as reported in Table 4A, have a significant and positive correlation with degree of familiarity.

Some association between high degrees of familiarity and high levels of quality assessment is perhaps largely to be expected, with journals with high quality articles being regularly read, leading to a high degree of familiarity. However, for the one journal with a significant negative correlation coefficient (*International Journal of Accounting, Auditing and Taxation*), respondents who were relatively familiar with this journal (i.e., 3 or more on the 5-point scale) appear to have perceived it to be of comparatively low quality. 'Familiarity' with a journal is, of course, a very general indicator of knowledge of the journal, although the existence of significant correlation coefficients will enhance confidence in the quality assessments because these are based on high levels of familiarity. However, very few examples exist of a significant relationship between the quality assessments of those with a major editorial involvement and their stated degree of familiarity. This contrasts with the 16 examples of a significant relationship (of which 15 were positive) between familiarity and quality assessment from those respondents who were categorised as not having a major editorial involvement. This result exposes the difficulty of using a term such as 'familiarity'. Do different categories of respondent use different criteria to determine their level of familiarity? Or are the criteria largely similar, but those with major editorial involvement less inclined to let journal familiarity affect their judgment of quality? Certainly, our results from Table 4A do seem to show that those with major editorial involvement seem less in awe of the top US journals.[12]

'Quality' is an equally difficult term to identify and define, and in order to gain an insight into respondents' perceptions of quality, they were asked to indicate, on a scale of 1 (not at all important) to 5 (very important), the criteria they used to arrive at their assessment of a journal's academic quality. The 'general quality of the articles published in the journal' received an average score of 4.81 (closely approximates to 5, a very important criterion). The 'subject area of the journal' was next in importance with a mean score of 3.47, followed by 'the difficulty of getting published in the journal' (mean score 3.31), and 'the research methodology generally followed in the journal' (mean score 3.30).

The categorisation of the overall assessments of quality by seniority and editorial involvement were tested for differences in ranking using the Mann Whitney test. This revealed no significant differences between the rankings of the mean quality assessment scores of senior staff and non-senior staff, or between the rankings of the mean quality assessment scores of those with major editorial involvement and those without such involvement. However, even though no significant differences existed in the overall rankings of journals, Tables 4A and 4B show differences in the mean quality assessment scores of specific journals. The significance of these differences was tested using the chi-square test as well as the two-tailed t-test for differences between means and ANOVA. These tests were undertaken on the *arithmetic* means recorded for each journal and not on the *geometric* means reported in Tables 4A and 4B. To avoid confusion with the asterisks representing significant correlation coefficients, statistically significant differences are not indicated in Tables 4A and 4B but are reported separately in the discussion below. The chi-square test found only one significant lack of association between the quality assessment scores of senior/non-senior staff and a further one between the editorial involvement/non-editorial involvement categories. As these are well within the range of normal sampling error, they have not been reported. Even the t-test and ANOVA (which produced virtually identical results) revealed only four significant between mean differences for the senior/non-senior categories and these were, using t-tests, as follows: *British Accounting Review* (significant at 1% level); *European Accounting Review* (significant at 5% level); *Australian Accounting Review* (significant at 5% level); and *Behavioral Research in Accounting* (significant at 5% level). For the first three of these the non-senior respondents gave the highest mean score, but such a low number of significant differences suggests that seniority has little discernible impact on assessments of journal quality.

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[12] Research would certainly be useful to throw more light on the process of perception formation by the various constituencies of accounting academics.

When examining the impact of editorial involvement, our results showed that for the following nine journals the mean quality assessment scores for the two categories of respondents were significantly different using t-tests: *Journal of Finance* (significant at 5% level); *Journal of Financial and Quantitative Analysis* (significant at 5% level); *Journal of Accounting and Economics* (significant at 1% level); *Journal of Accounting Research* (significant at 1% level); *The Accounting Review* (significant at 10% level); *Behavioral Research in Accounting* (significant at 10% level); *Abacus* (significant at 10% level); *Journal of Cost Management* (significant at 10% level); and *Accounting Horizons* (significant at 10% level).

This means that for each of the five top journals in terms of overall quality rating in Table 4A, the arithmetic mean score of non-editorial involvement respondents was significantly higher than for those with editorial involvement. All of these journals are American, three of them are finance journals, and they are all journals with which relatively few of our sample had any kind of involvement. Perhaps the respondents to our survey who had a major editorial involvement were more knowledgeable in terms of academic quality than their less heavily involved counterparts. Certainly, the weighting given to the top journals by these more experienced academics is markedly less than not only the non-editorial category, but also much lower than the overall score. For example, Table 4A shows that the overall geometric mean score for the *Journal of Finance* was 179.6, while for the non-editorial category it was 189. However, for the editorial category the mean score for this journal was 143.4.

As mentioned earlier, a number of the journals included in our sample were relative newcomers. Because of the possibility that judgments of these journals might be less robust than those for more well-established journals, these newer journals (less than three years old in the summer of 1993, the time of the survey) are reported separately in Table 4B. Two of the five newly established journals, *Australian Accounting Review* and *Research in Third World Accounting*, attracted very few responses. *Accounting Business and Financial History* achieved the overall highest score for quality, with the category of respondents having no significant impact on the scores.

There are four main limitations to this study. First, as in all attitude measurement studies, the results are necessarily subjective. In a sense this is also a strength of such a study, for one is arriving at individual perceptions of journal quality. Although no objective definition of research quality is achieved, Howard (1981) (as was discussed earlier) has argued that the magnitude estimation method of attitude measurement is more robust than alternatives, such as the Likert scale. Second, the representativeness of our sample to the overall population of active researchers/whole population of UK academics is unclear. We did not formally conduct a non-response bias test, because a postal strike created problems timing the receipt of the questionnaires. Moreover, when we tested the last 10% of responses against the majority of responses, we found no significant differences, using Mann Whitney. Gray and Helliar (1994) found that of the population of UK accounting and university academics, 66% had a professional accounting qualification and 30% possessed a PhD. Our sample closely approximates this with 65% having a professional accounting qualification, and 37% possessing a PhD. Third, the subjective nature of opinion-based survey has led some observers to suggest that they may be biased, especially through familiarity (for example, Levin and Kratochwill, 1976). In the main, however, research findings have not confirmed this. For psychology journals, Koulack and Keselman (1975) established that journal rankings are not related to either submissions, rejections or subscriptions. In the accounting field, Morris, Cudd and Crain (1990), after partitioning Howard and Nikolai's (1983) results into eight groups, determined that 'faculty ratings for a given journal group are not found to be associated with faculty publication records in that same group, suggesting the absence of a journal-specific ratings bias' (p. 46). Interestingly, they did find that those faculty members who had published in the top two accounting journals harboured a negative bias to more lowly placed journals. Whether this is actual bias or more knowledgeable judgment is, of course, a moot point. However, Morris, Cudd and Crain's findings are pertinent to this study. Fourth, there are several inherent limitations of attitude measurement, such as the lack of commonality of attitudes, the contradictory attitudes making up an individual's response, and potential deliberate rationalisation and deception (for a fuller discussion of these issues see Madge, 1980, pp. 108-203). These potential limitations, which are inherent to some degree in all attitude measurement studies, must be borne in mind when evaluating our study's results.

Conclusion

Overall, our analysis indicates that UK academics regard six, mainly American, established journals most highly: *Journal of Finance*; *Journal of Financial and Quantitative Analysis*; *Journal of Accounting and Economics*; *Journal of Accounting Research*; *The Accounting Review* and *Accounting, Organizations and Society*. Below these journals, with a range of scores from 108.6 to 95.1, came another 10 journals, including *Accounting and Business Research*. After these 16 journals the boundaries become less clear. Of the five relatively new journals, the specialist journal *Accounting, Business and Financial History* (81.9) achieved the highest rating. Particularly striking is the fact that UK academics rate mainly US journals the highest. This is despite the fact that UK academics publish, with a few notable exceptions, in UK based journals. Overall, therefore, UK academics collectively appear to rate their own research quality as inferior to their American counterparts. This issue is worthy of more research.

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Appendix

Journal titles and abbreviations used

Abacus (AUS)	*Abacus*
Accounting, Auditing and Accountability Journal (AUS)	*AAAJ*
Accounting and Business Research (UK)	*ABR*
Accounting and Finance (UK)	*Acc & Finance*

Accounting Business and Financial History (UK)	*Acc Bus & Fin Hist*
Accounting Education (UK)	*Accounting Education*
Accounting Historians Journal (US)	*Acc Hist Journal*
Accounting Horizons (US)	*Acc Horizons*
Accounting Review (US)	*Accounting Review*
Accounting, Organizations and Society (UK)	*AOS*
Advances in Accounting (US)	*Adv in Accounting*
Advances in International Accounting (US)	*Adv in Int Acc*
Advances in Public Interest Accounting (US)	*Adv in Pub Int Acc*
Auditing: A Journal of Practice and Theory (US)	*Auditing - Pr & Theory*
Australian Accounting Review (AUS)	*Australian Acc Review*
Behavioral Research in Accounting (US)	*Behav Res in Acc*
British Accounting Review (UK)	*BAR*
British Tax Review (UK)	*British Tax Review*
Business History (UK)	*Business History*
Contemporary Accounting Research (CAN/US)	*Cont Acc Res*
Critical Perspectives on Accounting (CAN)	*Crit Persp on Acc*
European Accounting Review (DEN)	*European Accounting Review*
Financial Accountability and Management (UK)	*Fin Acc & Man*
Financial Analysts Journal (UK)	*Fin Analysts Journal*
International Journal of Accounting (US)	*Int Journal of Acc*
International Journal of Accounting, Auditing and Taxation (US)	*Int J of Acc Aud & Tax*
Issues in Accounting Education (US)	*Issues in Acc Ed*
Journal of Accounting Auditing and Finance (US)	*J. of Acc Aud & Fin*
Journal of Accounting and Economics (US)	*J of Acc & Econ*
Journal of Accounting and Public Policy (US)	*J of Acc & Pub Policy*
Journal of Accounting Education (US)	*J of Acc Ed*
Journal of Accounting Literature (US)	*J of Acc Lit*
Journal of Accounting Research (US)	*J of Acc Res*
Journal of Business Finance and Accounting (UK)	*JBFA*
Journal of Cost Management (US)	*J of Cost Man*
Journal of Finance (US)	*Journal of Finance*
Journal of Financial and Quantitative Analysis (US)	*J of Fin & Quant Analysis*
Journal of International Financial Management & Accounting (US)	*J of Int Fin Mgt & Acc*
Journal of Management Accounting Research (US)	*J of Man Acc Res*
Management Accounting Research (UK)	*Man Acc Res*
Managerial Finance (UK)	*Managerial Finance*
Pacific Accounting Review (AUS)	*Pacific Acc Review*
Public Money and Management (UK)	*Public Money & Man*
Research in Third World Accounting (UK)	*Res in Third World Acc*

Book Review

Accounting as Social and Institutional Practice. *A.G. Hopwood and P. Miller* (eds.). Cambridge University Press. xi + 324pp. £15.95 paperback.

If you are looking for a classy (and erudite) collection on problematising accounting, look, as they say, no further than this book. The significance of accounting as social and institutional practice is increasing. Indeed, one of the book's key themes is the growing mobility and pervasiveness of accounting during the period from the 1900s to the 1990s.

Peter Miller comments in the introductory chapter that the focus throughout the book is '...on accounting as a practice, a view that accounting is, above all, an attempt to intervene, to act upon individuals, entities and processes to transform them and to achieve specific ends.' (p.1). With such a focus the book has a potentially broad interdisciplinary readership. Moreover, the contributors to the volume are already widely regarded as having been particularly influential, over the past decade, in shaping the thinking of the international academic accounting community on the issue of how accounting intersects with its social and organisational context.

I see a number of key themes running through the collection:

- the differentiating power of accounting as it makes visible and highlights all that is measurable in social and organisational life;
- the mobility of accounting as it penetrates and occupies social and organisational spaces in diverse domains;
- the displacing potentiality of accounting as it substitutes economic thinking for social thinking; and
- the ambiguity of accounting, as accounting categories are open to multiple constructions and accounting numbers are open to multiple interpretations: hence, accounting can conceal more than it reveals.

These key themes are articulated in various contexts by the authors in the volume's 12 chapters. Following on from the introductory chapter, Chapter 2 (Thompson) and Chapter 3 (Hoskin and Macve) both focus on the emergence of accounting as a calculative practice, stressing the significance of the dominant institutions of the time (the educational regimes, the church and the publishing houses) for the ways in which double entry bookkeeping was generated and established. Both chapters address accounting's ambiguity in construction and effects. For Thompson, this ambiguity is manifested in accounting's rhetorical nature, for Hoskin and Macve in its arbitrariness.

The next 10 chapters explore various themes on costing within organisations—highlighting the constructs of 'efficiency' and 'productivity' and showing how these constructs are articulated through calculative practices. Miller and O'Leary (Chapter 4) explicate the differentiating and displacing power of standard costing as it attaches economic norms and standards of behaviour to all a firm's members. Efficiency is made visible and calculable as its discourses displace those of politics in the deployment of resources. Chapter 5 (Loft) examines how cost accounting was mobilised during the First World War, showing how internal efficiencies within the firm '...could be "pulled out" and exposed to the governmental gaze' (p. 132) in order to be aggregated and further constituted as notions of national efficiency.

Bougen (Chapter 6) outlines accounting's displacing and, ultimately, disintegrating potentialities through narrating the effects consequent on the introduction of a profit-sharing scheme (which incorporated greater disclosure of accounting information to labour) at the Renold factory in the 1920s. While this scheme was intended to enhance productivity through releasing the synergies of a 'community of interest', the result was to expose the ambiguities of a managerialist accounting through disclosing its partial and partisan nature.

The 'productivity problem' is also the focus of Chapter 7 (Tomlinson), but the context for the discussion (as in Loft) links the enterprise with the national economy. As in Bougen, the 'productivity problem' is seen as residing with labour, and constructive solutions through management accounting again remain elusive. Chapter 8 (Armstrong) continues the focus on the intersection between management accounting and industrial relations, and here accounting's displacing power is seen as accounting information assumes increasing ascendancy within industrial relations policy.

The ambiguity of the 'value-added' accounting category is central to Chapter 9 (Hopwood, Burchell and Clubb). Here the proliferation of possible 'value-addeds' allowed a number of interested parties—the accounting profession, the government and the trade unions—to 'buy into' the concept. But although the category was generically attractive, it proved also to be time-specific. The value-added concept's mobility was suddenly curtailed as the social spaces it had penetrated (in the profession, the government and the trade unions) mutated—rendering the concept redundant.

Chapter 10 (McSweeney) locates accounting's mobility and its differentiating/displacing potentialities in the public sector. McSweeney recounts the series of initiatives within the public sector (from the 1960s onwards), which placed management accounting at the heart of public sector programmes to manage and rationalise its diverse activities.

The last two chapters shift contexts to explore facets of the accommodation between the state and the accounting profession. Chapter 11 (Cooper, Puxty, Robson and Willmott) brings the issue of the ambiguity of accounting into sharp focus, as flexibility is seen to compromise professional claims to objectivity and independence. Accounting's claim to be a mobile technology that can expand into areas such as consultancy and selling financial services can also unsettle the relationship between the profession and the state, and this chapter recounts the profession's attempts to reaffirm its legitimacy.

The final chapter of the book (Power) also explores mobility, this time in the context of auditing as 'audits' explode in areas of social life that were previously reliant on trust. Power highlights the political expediency of the ambiguity of audit, as the expectations gap is managed as a resource both for the profession and the state: '...auditors can help themselves to the high fees that correspond to high expectations and regulatory publics can help themselves to the appearance of high levels of assurance necessary to legitimate regulatory programmes.' (p. 305). Audits also displace public discourse on accountabilities by substituting expert control for democratic deliberation.

As an exemplar of good writing about problematising accounting, this collection must be pretty well unbeatable. But one is left with a picture of accounting as a disabling, even a destructive, technology. How far is this state of affairs inevitable?

Linked to the absence in the book of any answers to this question is the silencing of practitioners' voices. Only in the Loft chapter does a practitioner speak (and even then only very briefly). Could this be a reflection of the fact that there is only one woman out of the 19 contributors, and women are more frequently cast in a listening mode than are men?

Consequently, although avowedly about practice, the volume conveys little sense of what people were trying to achieve through accounting interventions, and, in the accounting events narrated, there are few analyses of how and why disabling effects overwhelmed any potentially enabling consequences. Also, the collection contains little that is truly new in terms of ideas (at least to the readers of *Accounting, Organisations and Society*). Nevertheless, the book does convey a profound understanding of accounting in its social and institutional context and it will, I think, become a classic volume, reflecting, as it does, the work of many highly-regarded scholars in the critical and socio-historical fields of accounting research.

University of Edinburgh Sue Llewellyn

Guide for Authors

General

Papers should be in English and consist of original unpublished work not concurrently being considered for publication elsewhere. They should be typed and double-spaced. *Four* copies should be submitted together with a submission fee of £18 for subscribers or £36 for non-subscribers. In order to ensure an anonymous review, authors should not identify themselves directly or indirectly. Experience has shown that papers which have already benefited from critical comment from colleagues at seminars or at conferences have a much better chance of acceptance. Where the research takes the form of field surveys or experiments, *four* copies of the instrument should be submitted. Where the paper shares data with another paper, *four* copies of the other paper must also be provided.

Presentation

A cover page should show the title of the paper, the author's name, title and affiliation, and any acknowledgements. The title of the paper, but not the author's name, should appear on the first page of the text. An Abstract of 150–250 words should be provided on a separate page immediately preceding the text. Authors are advised to observe the general style of presentation in papers already published, particularly in regard to the way text is sub-divided.

Tables and figures

Each table and figure should bear a number and a title and should be referred to in the text. Sources should be clearly stated. Sufficient details should be provided in the heading and body of each table and figure to reduce to a minimum the need for cross-referencing by readers to other parts of the manuscript. Tables and figures should appear at the end of the paper, with its most appropriate placing noted in the paper itself.

Footnotes

Footnotes should be used only in order to avoid interrupting the continuity of the text and should not be used to excess. They should be numbered consecutively throughout the manuscript with superscript arabic numerals. They should not be used in book reviews.

References

References should be listed at the end of the paper and referred to in the text as, for example, (Zeff, 1980, p. 24). Wherever appropriate, the reference should include a page or chapter number in the journal or book in question. Only works cited in the paper should be included in the list. Citations to institutional works should if possible employ acronym's or short titles. If an author's name is mentioned in the text it need not be repeated in the citation, e.g. 'Tippett and Whittington (1995, p. 209) state...'

In the list of references titles of journals should omit an initial 'The' but should not otherwise be abbreviated. The entries should be arranged in alphabetical order by surname of the first author. Multiple works by the same author should be listed in chronological order of publication. Some examples are:

Accounting Standards Steering Committee (1975), *The Corporate Report.*

Tippett, M. and Whittington, G. (1995), 'An Empirical Evaluation of an Induced Theory of Financial Ratios', *Accounting and Business Research*, Vol. 25, Summer, pp. 208–218.

Watts, R. L. amd Zimmerman, J. L. (1986), *Positive Accounting theory* (Englewood cliffs, NJ: Prentice-Hall).

Style and spelling

Abbreviations of institutional names should be written as, for example, FASB and not F.A.S.B; whereas those of Latin terms should contain stops (thus i.e. not ie). Words such as 'realise' should be spelt with an 's' not a 'z'. Single quotations marks should be used, not double.

Mathematical notation

Mathematical notation should be used only where it adds rigour and precision, and should be properly explained in the text. Equations should be numbered in parentheses, flush with the right-hand margin.

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Post-earnings-announcement Drift: Some Preliminary Evidence for the UK

Denis Hew, Len Skerratt, Norman Strong and Martin Walker*

Abstract—This paper tests for the presence of post-earnings-announcement drift on the London Stock Exchange using data for seven half-years for a constant sample of 206 quoted companies. Separate results are presented for interim and final earnings announcements and the results are disaggregated by firm size. Overall, we find evidence of significant drift for the earnings announcements of small firms but not for the announcements of large firms.

1. Introduction

Over the last quarter of a century a number of US research studies have reported an empirical phenomenon that has come to be known as post-earnings-announcement drift (henceforth referred to as PAD). Loosely speaking, the PAD phenomenon can be described as a tendency for abnormal stock returns to be predictable on the basis of past earnings news. In other words, share prices fully react to earnings news only with a considerable lag.

The PAD phenomenon directly challenges the semi-strong form of the efficient markets hypothesis (EMH), which states that the market reacts fully and instantaneously to all publicly available information. Of all the various sources of public information about a company, earnings is generally regarded as the single most important, regularly reported item (see, for example, Beaver, 1981, p. 135). Thus, if it can be shown that market prices fail to fully impound earnings information, this will seriously undermine the EMH. It is primarily for this reason that many leading academics regard PAD as one of the most serious empirical challenges to the EMH (see Ball, 1992 and Lev and Ohlson, 1982).

This paper reports the results of the first systematic study of PAD based on UK company data. Several researchers have replicated the PAD phenomenon using US company data, but there is no comparable UK study. Work on a different market with a different frequency of earnings reporting is important for two reasons. First, one needs to know whether the PAD phenomenon is replicable outside the US market where it was first discovered (for early evidence on this, see Ball, 1978). Second, such research may help in understanding the reasons for PAD. Recent US research in this area has taken the existence of PAD as its starting point, and has gone on to explore possible explanations for the phenomenon (see, for example, Bernard and Thomas, 1990; Bartov, 1992; Bhushan, 1994; Bernard et al., 1995). In particular, Bhushan (1994) has presented evidence that transaction costs and other trading frictions may be the main reason why PAD is not arbitraged away. Since the London stock market's trading record is generally indicative of considerable trading frictions, one would expect even stronger evidence of PAD in London than in New York if Bhushan's hypothesis is correct.

The remainder of this paper is set out as follows. Section 2 briefly reviews the relevant US literature and states the hypotheses to be tested. Section 3 discusses the main features of our research design. Section 4 presents details on our data sources and provides evidence of increases in share price volatility on the days that our sample companies announce their final and interim earnings. The main results of the paper are presented in Section 5. The final section contains our conclusions and suggestions for further research.

---

*The authors are at the University of Manchester. This paper is dedicated to the memory of Vic Bernard, who died tragically last year. Vic provided the inspiration for this project and gave generously of his time and advice in its formation stage. The authors all had great respect for him, both as an academic and as a human being. They are grateful to the UK Inquire group for sponsoring this project and to Peter Pope for helpful encouragement and advice. The cooperation of Extel Financial Ltd in the data collection phase is also gratefully acknowledged. The authors are particularly grateful for the comments of two anonymous referees. Any remaining errors are the joint responsibility of the authors. Correspondence should be addressed to Professor Martin Walker, Centre for Interdisciplinary Research in Accounting and Finance, Department of Accounting and Finance, University of Manchester, Oxford Road, Manchester M13 9PL. This article was first submitted in March 1995 and accepted in May 1996.

2. Related literature and explanation of the hypotheses to be tested

Post-earnings-announcement drift has been studied extensively for over a quarter of a century in the US. Ball and Brown (1968) were the first to observe that even after earnings are announced, estimated cumulative abnormal returns continue to drift upwards for firms with better than expected earnings results ('good news' firms) and downwards for firms with lower than expected earnings results ('bad news' firms).

Surveys of the evidence for PAD published in the 10 years following Ball and Brown (1968) can be found in Ball (1978) and Joy and Jones (1979). The early studies suffered from a variety of limitations in their research design that could have biased their results, but these potential errors were recognised and controlled for in the subsequent papers of Foster, Olsen and Shevlin (1984) and Bernard and Thomas (1989), both of which reported clear evidence of PAD. The present study's research design relies heavily on these two papers.

The more recent US papers have taken the existence of PAD as their starting point and have attempted to test alternative explanations of the phenomenon. Bernard and Thomas (1990), Wiggins (1991) and Bartov (1992) have presented evidence suggesting that PAD may be due in part to the market making systematic errors in inferring the implications of recent earnings news for future reported earnings.

Probably the most persuasive evidence consistent with this particular explanation for PAD is the finding reported both by Bernard and Thomas (1990) and by Wiggins (1991), which shows that the unexpected earnings of quarter t can be used to predict the three-day stock price response to earnings announcements for quarters $t+1$ through to $t+4$. In particular, unexpected earnings reported for quarter t are positively correlated with the share price movements when earnings are announced for quarter $t+1$ to $t+3$ and *negatively* correlated with the share price movements when earnings are announced for quarter $t+4$. Because of the semi-annual nature of the UK reporting environment it is not possible to replicate this result on UK data. The closest equivalent result we test for below is a positive correlation between the unexpected earnings reported for half-year h and the share price movements when the earnings are announced for half-year $h+1$.

Another possible cause of PAD is the presence of significant transaction costs. The papers of Bernard and Thomas (1989, 1990) present arguments and evidence suggesting that PAD cannot be explained by transaction costs alone. However, a recent paper by Bhushan (1994) has shown how transaction costs, in combination with differing information-processing abilities among investors, can result in PAD. Bhushan (1994) also presents new evidence consistent with his theory. In particular, he shows that the degree of drift is significantly positively correlated with proxies for transaction costs. In other words, drift is particularly pronounced for stocks with high values of the proxies Bhushan employs for the direct and indirect costs of trading. Bhushan finds that PAD is not significant for low transaction cost firms experiencing unexpected good news, but that it remains significant for low transaction cost firms experiencing unexpected bad news. Bhushan speculates that the asymmetry of the good news and bad news PAD could be due to the extra transactions costs associated with short selling.[1]

The main purpose of this paper is to test for the presence of PAD in UK data. Our null hypothesis is that share price performance after an earnings announcement is unrelated to whether the earnings news at the time of the announcement is good news or bad. Tests of this hypothesis are the main results presented in Section 5. In addition, this section examines the extent to which drift is associated with company size, which we interpret as a crude proxy for the inverse of trading and research costs.[2]

3. Research design

The basic approach we follow is detailed in Foster et al. (1984) and Bernard and Thomas (1989). The research focuses on seven sets of earnings announcements, starting with the finals announcements for 1989, and finishing with the finals for 1992. In aggregate, this represents 1,442 announcements, 206 firms times seven announcements.[3]

For each firm and each announcement we construct a measure of the earnings surprise associated with that announcement. For our main tests, we partition the 1,442 announcements into five earnings surprise portfolios, ranging from portfolio one, containing the announcements conveying very bad news, to portfolio five, containing the announcements conveying very good news. Our main tests are then based on the abnormal returns of these portfolios over several periods of interest on and around the announcement dates.

The remainder of this section describes the details of our research design. The method we use to estimate abnormal returns is described in 3.1. The particular model we use to measure earnings surprise, and the procedures we use to group firms into earnings surprise portfolios, are described in subsection 3.2. Subsection 3.3 outlines the technique we employ for testing the statistical significance of our findings.

---

[1] Our results on UK data, reported below, *do not* support Bhushan's hypothesis.

[2] We considered using a trading volume measure as an alternative proxy for transactions costs. Unfortunately, complete UK trading volume data on most of our sample companies was not formally recorded before 1991.

[3] We report details of how we selected this sample in Section 4.

3.1. Estimating Abnormal Returns

We calculate daily returns for all the firms in the sample using daily share price data from Datastream. These returns are adjusted for dividends using the dividend data and the dividend payment dates in the London Share Price Database. We define R_{it} as the return on the equity of firm i on day t.

From the sample of 206 companies we define four size-based portfolios. We define s_i as the size portfolio to which firm i is assigned and $R(s_i - i, t)$ as the equally weighted returns on day t of all the equities in size portfolio s_i except firm i. The abnormal return of firm i on day t is given by,

$$AR_{it} = R_{it} - R(s_i - i, t) \qquad (1)$$

Equation (1) states that the abnormal return for firm i on day t is the difference between the return for that firm and the corresponding return for firms in the same size portfolio.[4]

It is of some interest to note that the method we use to calculate the returns for benchmark portfolios of firms of similar size differs from the method used in previous studies. Previous approaches compare the returns of sample firms with an index based on all firms in the same size decile. Such indices include both surviving and non-surviving firms, so there is a potential for survivorship bias to be induced by comparing the returns of sample firms, which have some survivorship restriction imposed, with the index, which is not restricted. If non-surviving firms underperform, these approaches are biased in favour of finding positive abnormal returns. Since our benchmark portfolios consist of firms with the same survivorship properties as our sample, our tests for PAD are less likely to be affected by survivorship bias than previous studies.

3.2. Identifying Earnings Surprises

To test for post-earnings-announcement drift, the standard procedure is to first rank firms into portfolios based on their unexpected earnings. To do this we need a model of unexpected earnings. For the current study our primary model is a statistical earnings forecast based on time-series data.

Although there is a sizeable literature on the properties of US companies' quarterly earnings, no comparable studies exist for UK companies' half-yearly earnings. The procedure we follow here is to adopt Foster's (1977) model applied to half-yearly data,

$$X_{ih} - X_{ih-2} = \delta_i + \phi_i(X_{ih-1} - X_{ih-3}) \qquad (2)$$

where X_{ih} is company i's earnings for half-year h. Equation (2) models earnings as a first-order autoregressive process in seasonal differences. Applied to quarterly earnings, Foster found this model performed best of six models in forecasting future earnings. Both Foster, Olsen and Shevlin (1984) and Bernard and Thomas (1989) have used the Foster model in studies of post-earnings-announcement drift.[5,6]

For each half-year in our test period 1989–1992, we estimate equation (2) individually for each firm using the series of observations beginning in 1984 and ending six months before the half-year of interest. So for interim earnings in 1990, we estimate equation (2) using 12 observations from interim earnings in 1984 to final earnings in 1989. The minimum number of observations is 11[7] (for 1989 finals) and the maximum number of observations is 19 (for 1992 finals).

Unexpected earnings for company i for half-year h are,

$$UE_{ih} = X_{ih} - \mathrm{E}(X_{ih}), \qquad (3)$$

where expected earnings, from equation (3), are,

$$\mathrm{E}(X_{ih}) = X_{ih-2} + \delta_i + \phi_i(X_{ih-1} - X_{ih-3}) \qquad (4)$$

Following previous studies, we divide by the standard error of unexpected earnings to give *standardised unexpected earnings* (SUE),

$$SUE_{\mathrm{ih}} = \frac{UE_{ih}}{\sigma(UE_{ih})}, \qquad (5)$$

---

[4] This implicitly defines the expected return for firm i on day t as the mean return across other sample firms of the same size on day t.

[5] A variation on our basic research design, reported below, attempts to improve on this time-series benchmark, by updating for information reflected in price between the date of the earnings announcement and the date of the time-series forecast, approximately six months earlier.

[6] An alternative to time-series models of earnings, popular in the literature, is to use analysts' earnings forecasts. This was not possible here, as many small UK firms have no analyst following.

[7] The fact that we only have half-yearly data already puts us at a disadvantage over US researchers, who have quarterly data. We also had to collect most of the interims earnings data by hand, and this may have induced some errors. Such problems are likely to bias the results towards the null hypothesis that there is no PAD.

Table 1
Descriptive Statistics on Standardised Unexpected Earnings (SUEs)

	Interim earnings	*Final earnings*	*All earnings*
Mean	−0.33	−0.63	−0.50
Standard deviation	1.87	2.66	2.36
Maximum	7.68	7.83	7.83
Q3	0.54	0.71	0.63
Median	−0.18	−0.22	−0.21
Q1	−1.09	−1.63	−1.33
Minimum	−14.83	−28.01	−28.01

Note: Table 1 reports descriptive statistics for standardised unexpected earnings. The sample contains 618 observations on interim earnings and 824 observations on final earnings, 1,442 in total. SUE is calculated as the standardised prediction error from a first-order autoregressive model for seasonally differenced earnings, estimated separately for each firm on earnings for the period starting in 1984 and ending six months before the half-year of interest. We divide by the standard error of the prediction error to give SUE.

where,

$$\sigma(UE_{ih}) = s_i \sqrt{1 + \frac{1}{S} + \frac{(UE_{ih} - \overline{UE}_i)^2}{\sum_s (UE_{is} - \overline{UE}_i)^2}}, \qquad (6)$$

and

s_i^2 is an estimate of the variance of unexpected earnings during the estimation period;
UE_{is}, $s = 1, \ldots, S$ are the estimation period earnings observations;
$\overline{UE}_i$ is the mean estimation period earnings.

With a sample of 206 companies, and three years of interim earnings and four years of final earnings in our test period, we have a final sample of 1,442 observations on SUEs: 618 for interims and 824 for finals. We rank these observations into five portfolios based on SUEs. Portfolio one comprises the lowest SUE observations (very bad news) while portfolio five comprises the highest SUE observations (very good news).

Following previous studies, we take care to avoid hindsight bias. Hindsight bias would be present if our criterion for ranking used information not available at the time of the earnings announcement. For example, if we simply ranked all firms' SUEs for a half-year and formed quintile portfolios, we would be assuming that when the first firm made its earnings announcement, we also knew the earnings of firms still to disclose for that half-year. In fact, an investor could only apply this ranking criterion on the date when the last firm discloses for that half-year.

To avoid this, we base the cut-off points for deciding SUE portfolios for interim earnings on the SUE rankings for the previous finals, and similarly for the final earnings on the SUE rankings for the previous interims. For example, when we consider SUEs for 1991 finals, when the first firm discloses its finals, we do already know the SUEs for interims in 1991 for all firms in the sample. Ranking the SUEs for 1991 interims gives us four cut-off points. We use these cut-off points to decide to which of five portfolios we assign each firm in respect of its 1991 finals. In effect, we decide in which portfolio a firm's 1991 finals would have placed it, if it had instead announced these earnings in the immediately prior half-year.[8]

We report descriptive statistics for SUEs in Table 1. The Table shows the median SUE is approximately zero for interims, finals and the pooled sample of observations. There is a greater spread of observations for announcements of final earnings than for interim earnings.

The main results we present below are based on SUE portfolios formed as described above. We also report summaries of the results produced by two variations of our basic portfolio formation method. In the first variation, rather than using the previous half-year's SUE cut-off points in forming portfolios, we use the cut-off points from the corresponding half-year of the previous finan-

---

[8] We do not entirely eliminate hindsight bias here. Whereas US studies group earnings by calendar quarter, our grouping is by interims and finals. This means, for example, that if a firm has a financial year-end early in the calendar year, when it announces its finals, some firms with financial year-ends late in the calendar year may still not have announced their interims for the year. However, over 70% of our sample have December year-ends, so we do not believe this source of bias will significantly affect our results. A variation on the portfolio formation procedure eliminates hindsight bias entirely (see below).

Table 2
Size Distribution of the Study Sample

Size	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*
1	61	56	51	59	58	57
2	54	58	59	57	55	45
3	61	60	54	56	57	59
4	30	32	42	34	36	45

Note: The companies are grouped into four size portfolios using market capitalisation on 1 January of each year. The four size ranges are defined as:

Size portfolio	
1	0 to £50m
2	£51m to £200m
3	£201m to £1000m
4	£1001m and above

Table 3
Average Squared Abnormal Returns Around Earnings Announcements

DAY	*INTERIMS* $(\times 10^3)$	*FINALS* $(\times 10^3)$	*ALL* $(\times 10^3)$
−3	0.48	0.44	0.46
−2	0.94	0.65	0.78
−1	0.84	0.29	0.52
0	4.42	2.92	3.56
1	1.15	1.17	1.16
2	0.45	0.40	0.42
3	0.81	0.34	0.55

Note: DAY is relative to the announcement day (DAY 0). INTERIMS shows the average squared abnormal return for the 618 interim announcements. FINALS shows the average squared abnormal returns for the 824 finals announcements. ALL shows the pooled results for all 1,442 announcements.

cial year, that is, we use the cut-off points for the previous year's interims (finals) to classify the current year's interims (finals) into portfolios.

The second variation we report attempts to improve the time-series earnings forecast by making use of the information in the abnormal returns in the half-year between the date the forecast is formed and the date the actual earnings are announced.[9] The particular technique we use to implement this idea is based on Wilson (1986). For a given half-year, h, we produce revised SUEs as follows.

Step 1. For the *previous* half-year, estimate a *cross-section* regression of the form,

$$SUE_{ih-1} = a_{h-1} + b_{h-1}\, CAR_{ih-1} + e_{ih-1} \quad (7)$$

where CAR_{ih-1} is the cumulative abnormal return of company i in the six-month run-up to the earnings announcement for half-year $h-1$.

Step 2. For half-year h, use the estimated values of a_{h-1} and b_{h-1} to predict SUE_{ih} conditional on CAR_{ih},

$$E(SUE_{ih}|CAR_{ih}) = \hat{a}_{h-1} + \hat{b}_{h-1}\, CAR_{ih} \quad (8)$$

Step 3. Calculate the revised SUEs, denoted

---

[9] We are grateful to one of the anonymous referees for suggesting this to us.

Table 4
Average Cumulative Abnormal Returns in the Pre-announcement Periods and Announcement Day Abnormal Returns by SUE Ranks

	Interims		*Finals*		*Aggregate*	
Sue rank	*Days −60 to −1*	*Day 0*	*Days −60 to −1*	*Day 0*	*Days −60 to −1*	*Day 0*
1	−0.071	−0.021	−0.024	0.004	−0.036	−0.002
2	−0.025	−0.016	−0.008	0.005	−0.016	−0.004
3	−0.009	0.001	−0.006	0.013	−0.008	0.005
4	0.007	0.004	−0.001	0.016	0.003	0.010
5	−0.018	0.009	0.023	0.015	0.009	0.013
p975 (5% level)	0.043	0.021	0.025	0.010	0.024	0.010
p995 (1% level)	0.054	0.027	0.034	0.015	0.031	0.013
5 minus 1	0.054*	0.030**	0.048**	0.010*	0.045**	0.015**
	(2.08*)	(2.37*)	(2.81**)	(2.03*)	(3.21**)	(2.83**)

Note: The five SUE portfolios range from SUE rank 1, which denotes the very bad news portfolio, to SUE rank 5, which denotes the very good news portfolio.

* significant at 5% level
** significant at 1% level

p975 = 2.5% tail of randomisation distribution
p995 = 0.5% tail of randomisation distribution

RSUE as,

$$RSUE_{ih} = SUE_{ih} - E(SUE_{ih}|CAR_{ih}) \quad (9)$$

We can then re-form our portfolios using the RSUEs.[10]

3.3. Testing for Statistical Significance

A number of studies have shown that daily abnormal returns cannot reasonably be assumed to be normally distributed either cross-sectionally or over time. For this reason, we employ bootstrapping and numerical randomisation techniques for hypothesis testing. The significance tests we report test whether the mean return of the highest SUE portfolio (M5, denoting very good news) is significantly different from the mean of the lowest SUE portfolio (M1, denoting very bad news).

4. Data sources and event day validation

4.1. Sample Selection and Data Collection

The study required semi-annual earnings data for a large sample of UK companies, and the interim and final earnings announcement dates for these companies for the seven half-years starting with 1989 finals. Semi-annual data were not readily available to us in machine readable form and had to be collected from Extel. Most of the data on earnings and announcement dates were collected by one of the authors from files made available by Extel. Cost considerations forced us to limit the sample size to around 200 companies. The sample size we used was considerably less than the very large US studies. For example, Bernard and Thomas (1989) is based on 85,000 quarterly earnings announcements. We are limited to 'only' 1,442 announcements. However, we believe the sample size we use is large enough for reliable statistical inference. Indeed, we would be suspicious of any effect that manifested itself only in very large samples.

The data were collected from Extel in two phases. In the first phase we randomly selected 404 firms from the list of all the companies in LSPD quoted at any time in the period 1979–1992 that had December financial year-ends. Of these 404 companies, 251 traded in 1979, of which 139 survived through to December 1992. The fact that 45% of the firms quoted in 1979 were no longer quoted in 1993 gives an indication of the scope for survivorship bias in studies of this kind. This issue has not been studied here, but is clearly worthy of exploration. Recently, Brown and Pope (1995) have argued that survivorship bias could partially explain post-earnings-announcement drift.

Our original sample of 404 companies contained 252 companies that were traded throughout the 11-year period 1982 to 1992. For these we were

---

[10] The procedure requires an additional half-year of data compared to the time-series approach. Because of this, we were forced to use the SUE cut-off points for the first of the seven half-years when implementing this procedure. For the final six half-years, we used the RSUE cut-off points.

Table 5
Cumulative Abnormal Returns in Various Post-announcement Periods Partitioned by SUE Ranks

Sue Rank	*Days +1 to +10*	*Days +1 to +60*	*Days +1 to +120*	*Days +1 to +180*	*Days +120 to +240*
Panel A: Interims					
1	−0.003	−0.011	−0.036	−0.035	−0.028
2	0.014	−0.008	−0.0004	0.008	−0.002
3	0.019	0.016	0.010	0.039	0.040
4	0.009	0.007	−0.002	0.047	0.067
5	0.014	0.004	−0.005	0.035	0.026
p975 (5% level)	0.023	0.042	0.058	0.066	0.068
p995 (1% level)	0.030	0.057	0.075	0.091	0.090
5 minus 1	0.018	0.015	0.031	0.069*	0.055
	(1.20)	(0.62)	(0.96)	(1.75)	(1.46)
Panel B: Finals					
1	0.009	0.004	−0.019	−0.043	−0.055
2	0.015	0.021	0.019	0.020	−0.001
3	0.014	0.012	−0.001	0.020	0.001
4	0.010	0.051	0.068	0.070	−0.006
5	0.021	0.038	0.034	0.032	0.0001
p975 (5% level)	0.012	0.031	0.042	0.048	0.041
p995 (1% level)	0.016	0.037	0.049	0.064	0.058
5 minus 1	0.012*	0.035*	0.052**	0.074**	0.055*
	(1.92)	(2.55*)	(2.63**)	(3.25**)	(2.67**)
Panel C: Aggregate					
1	0.006	0.0002	−0.023	−0.041	−0.047
2	0.014	0.008	0.011	0.015	−0.001
3	0.017	0.014	0.006	0.032	0.027
4	0.009	0.028	0.032	0.058	0.036
5	0.019	0.026	0.020	0.033	0.010
p975 (5% level)	0.011	0.022	0.032	0.041	0.035
p995 (1% level)	0.015	0.032	0.040	0.050	0.049
5 minus 1	0.013*	0.026*	0.043**	0.073**	0.057**
	(2.08*)	(2.25*)	(2.61**)	(3.85**)	(3.02**)

* significant at 5% level
** significant at 1% level

p975 = 2.5% tail of randomisation distribution
p995 = 0.5% tail of randomisation distribution

able to construct a complete set of data for only 58 companies.[11] The incidence of missing values seemed to us to be purely random and unlikely to have induced any significant sample selection bias.

To implement the research design of previous studies, we needed to augment our sample beyond the 58 firms yielded by the first phase of data collection. This was achieved by selecting a further 239 companies from the 1,064 companies in Extel's Analysts Service Index.[12] Of these we were able to put together a complete data set for 148 companies. Since Extel's Analysts Service Index is biased towards larger companies, our sample is biased accordingly. This selection bias is likely to bias our results against finding PAD. To allow for this potential bias, the final section of the paper presents a separate analysis of PAD and firm size. Table 2 describes the start-of-year size distribu-

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[11] We required daily returns for the entire period, annual earnings, annual earnings per share, interim earnings, interim earnings per share, and the announcement dates for interims, finals and the annual report. The principal reason for the loss of companies was occasional missing values either in the earnings records or in the announcement date records.

[12] Because of the poor success rate in phase one, we were forced to broaden our sample selection criterion to include non-December year-end companies.

Table 6
Cumulative Abnormal Return from Day +1 to Next Earnings Announcement Day and Abnormal Returns on the Next Earnings Announcement Day Partitioned by SUE Rank

	Interims		*Finals*		*Aggregate*	
Sue rank	*Day +1 to next ann. day*	*Next ann. day*	*Day +1 to next ann. day*	*Next ann. day*	*Day +1 to next ann. day*	*Next ann. day*
1	−0.041	0.014	−0.045	−0.011	−0.044	−0.004
2	−0.000	0.010	−0.003	−0.002	−0.002	0.004
3	−0.018	0.009	−0.007	0.006	0.011	0.008
4	0.008	0.016	0.063	−0.005	0.029	0.008
5	−0.008	0.016	0.026	0.005	0.013	0.009
p975 (5% level)	0.060	0.016	0.047	0.014	0.035	0.010
p995 (1% level)	0.079	0.020	0.060	0.019	0.045	0.015
5 minus 1	0.033*	0.002	0.071**	0.016*	0.057**	0.013**
	(0.95)	(0.23)	(3 13**)	(2.10*)	(2.95**)	(2.21**)

* significant at 5% level
** significant at 1% level

p975 = 2.5% tail of randomisation distribution
p995 = 0.5% tail of randomisation distribution

tions of the final sample in terms of market capitalisation. It is worth noting that the sample contained a good spread of firm sizes including sizeable proportions both of small companies (market capitalisation of less than £50m) and large companies (market capitalisation greater than £1bn). Compared with the actual size distribution of firms on the LSE, our sample contained a larger proportion of large firms. For example, the 1991 size distribution for all LSE-quoted companies was 63%, 20%, 11% and 6% in our size categories 1 to 4 (see Table 2). The corresponding size distribution for our sample was 29%, 27%, 27% and 17%.

Of the 206 companies in the sample, some 146 have December year-ends. The next most frequently represented year-end is March, for which we have 18 companies. There is also a degree of announcement-day clustering. Of the 1,442 announcement days, 444 (31%) involve only one firm. A further 552 (38%) involve a cluster of between two to four firms. The remaining 446 announcements involve a cluster of between five and 12 firms.

4.2. Volatility Changes Around Earnings Announcements

As part of the data validation exercise, we need to satisfy ourselves that the earnings announcement dates we collected are reliable. To check this, we perform a test for increased share price volatility on the earnings announcement day relative to the two days either side of the announcement. Table 3 evidences a sharp increase in volatility, both for interims and for finals. We construct bootstrap *t* tests to compare day zero with days −3 to −1 and +1 to +3. We find the volatility on day zero to be consistently greater than every one of the other days at the 1% level.

We find no compelling evidence on the issue of whether volatility increases more around interims or finals. Table 3 shows that interims had the higher average day zero volatility. However, our tests for the statistical significance of the increase in volatility on day zero indicate that the increase around finals is more significant than around interims. On balance, we are inclined to the view that there is no great difference between the two events in terms of volatility changes.

5. Results

We first present results based on the standard research design. We then report evidence relating to the sensitivity of our findings to the way in which the SUE portfolios are formed.

5.1. Main results

Table 4 reports the abnormal share price performance of the five SUE rank portfolios over the 60 days prior to the earnings announcements and on the day of the announcements. We focus specifically on the abnormal returns associated with buying the very good news portfolio (portfolio 5) and shorting the very bad news portfolio (portfolio 1). These are reported in the row labelled '5 minus 1'. The values reported in the rows labelled p975 and p995 are the cut-off points established by the randomisation tests for the signifi-

Table 7
Test for Size Effect on 120-day Post-earnings-announcement Drift

Sue Rank	*Size 1*	*Size 2*	*Size 3*	*Size 4*
Panel A: Interims				
1	−0.186	−0.077	0.018	0.057
2	−0.036	0.022	0.019	−0.016
3	0.017	0.023	−0.002	−0.006
4	−0.018	0.014	−0.008	0.008
5	0.023	−0.026	−0.011	0.004
p975 (5% level)	0.167	0.111	0.105	0.102
p995 (1% level)	0.212	0.150	0.129	0.119
5 minus 1	0.208*	0.050	−0.029	−0.053
	(2.27*)	(0.98)	(−0.62)	(−0.78)
Panel B: Finals				
1	−0.016	−0.010	−0.021	−0.032
2	0.029	0.021	−0.018	0.046
3	0.003	−0.019	0.015	−0.009
4	0.075	0.081	0.070	0.039
5	0.065	0.034	0.021	0.008
p975 (5% level)	0.106	0.084	0.061	0.070
p995 (1% level)	0.139	0.106	0.079	0.095
5 minus 1	0.081	0.044	0.042	0.040
	(1.76)	(1.08)	(1.35)	(1.04)
Panel C: Aggregate				
1	−0.045	−0.029	−0.012	−0.005
2	0.002	0.022	−0.0001	0.024
3	0.012	0.009	0.005	−0.007
4	0.026	0.046	0.033	0.023
5	0.051	0.015	0.007	0.007
p975 (5% level)	0.076	0.066	0.051	0.058
p995 (1% level)	0.105	0.083	0.062	0.083
5 minus 1	0.095*	0.044	0.019	0.011
	(2.27*)	(1.27)	(0.69)	(0.35)

Note: Size category 1 denotes the smallest companies, size category 2 the next smallest and so on.

* significant at 5% level
** significant at 1% level

p975 = 2.5% tail of randomisation distribution
p995 = 0.5% tail of randomisation distribution

cance of the values reported in the row labelled '5 minus 1'.

For example, the value of 0.045 is greater than the cut-off value p995, so we attach two 'star' superscripts to this figure to denote significance at the 1% level. The figures reported in brackets in the row labelled '5 minus 1' are the bootstrap *t* values where a single (double) star superscript is attached if the value is significant at the 5% (1%) level. The aggregate results are qualitatively similar to the findings of previous US studies, with bad news firms experiencing share price declines and good news firms experiencing share price appreciation. In particular, portfolio 5 significantly outperforms portfolio 1. The separate results for interims and finals are also broadly in line with previous studies, though it should be noted that the 60-day pre-announcement abnormal return of SUE rank portfolio 5 under interims is negative (though not significantly so), and the day zero abnormal return of SUE rank portfolio 1 under finals is positive (though not significantly so).[13]

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[13] A worrying feature of the 'finals' results reported in Table 4 is that, in principle, the day zero abnormal returns should average to zero over the five SUE portfolios. Instead, all five

Table 8
Summary Aggregate Results Based on Revised SUEs (RSUEs)

RSUE rank	*Days −60 to −1*	*Day 0*	*Days +1 to +10*	*Days +1 to +120*	*Days +1 to +180*
1	−0.007	−0.002	0.002	−0.015	−0.029
2	0.005	0.002	0.013	0.018	0.017
3	0.004	0.004	0.013	0.011	0.031
4	−0.014	0.009	0.020	0.014	0.045
5	−0.034	0.011	0.017	0.015	0.031
p975 (5% level)	0.027	0.009	0.011	0.033	0.044
p995 (1% level)	0.034	0.011	0.016	0.047	0.060
5 minus 1	−0.024	0.012**	0.014*	0.030	0.060**
	(−1.78)	(2.47)	(2.37)	(1.73+)	(2.88)

+ significant at 10% level
* significant at 5% level
** significant at 1% level

p975 = 2.5% tail of randomisation distribution
p995 = 0.5% tail of randomisation distribution

Tables 5, 6 and 7 report our findings on PAD. Table 5 reports the cumulative abnormal returns of the SUE rank portfolios for various periods following the announcement day. The strongest result we obtain is for the 180-day post-announcement period (Table 5) for which portfolio 5 outperforms portfolio 1 by around 7%. Unlike the comparable US studies, we do not find a high degree of drift in the days immediately following the announcement. Specifically, there is no significant difference between portfolios 1 and 5 in the 10 days following the interim announcements. However, we do find, as in previous US studies, that the drift continues for a considerable period after the announcement. The final column of Table 5 (Aggregate) also reports significant drift for the period +120 to +240.

Table 6 reports the cumulative abnormal return from day +1 to the next earnings announcement and the abnormal return on the next announcement. The latter test is particularly interesting because it is similar to the one carried out by Bernard and Thomas (1990). In results not reported in tables, we find the mean first-order correlation in seasonally differenced half-year earnings to be a significant 29%. This compares with figures of 34% and 19% reported by Bernard and Thomas (1990) for mean first- and second-order correlations in seasonally differenced *quarterly* earnings. We find the mean second-order correlation to be negative at −0.025, but this is not significant.[14] The aggregate results suggest significant drift over the half-year following an announcement. In addition, it would appear that a significant jump in the drift occurs at the time of the next announcement. This latter result is similar to, though not as pronounced as, that reported by Bernard and Thomas (1990) for US companies.

A number of the studies cited above have suggested that PAD could be due to trading frictions and/or other factors likely to be associated with company size. Table 7 provides evidence on the relation between PAD and firm size for UK companies. Our aggregate results suggest that PAD is not a significant phenomenon for large (size category 4) UK companies, which are the most actively researched and traded companies. Conversely, PAD is fairly pronounced for small companies (size category 1). The evidence for middle-range companies is mixed and, in our view, inconclusive. The PAD effect is economically substantial (around 9.5%) and statistically significant only for the interim announcements of small firms. This may be because these are the earnings announcements to which the market pays least attention.

5.2. *Alternative SUE Portfolio Constructs*

When we use the SUE cut-offs for the corresponding half-year of the previous financial year, the results corresponding to Table 5 (Aggregate) and Table 6 (Aggregate) are essentially unchanged, with the exception that the 5 minus 1 statistics for days 1 to 10 in Table 5 is no longer statistically significant. The results corresponding to Table 7 are also essentially unchanged. We find statistically significant drift for size quartile 1.

Table 8 reports the aggregate results produced by forming our portfolios using the RSUEs calculated using equations (7) to (9). These results are

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values are positive, with an average value of 1%. This suggests that there may be a problem with the way the SUEs have been calculated.

[14] The corresponding fourth-order correlation reported by Bernard and Thomas (1990) is −0.24.

broadly similar to those reported in Tables 4 to 6, although the size and significance of the PAD is slightly lower. When we produce results disaggregated by size portfolios, we continue to detect statistically significant drift only in the first size quartile.

6. Conclusions and suggestions for further research

This paper is the first major study of PAD using UK data. Relative to US research in the area, the study encountered severe data limitations, so the findings must be treated with even more than usual caution.

Our interpretation of the results is that there is evidence of PAD for the bottom quartile of the size range of our sample (which roughly corresponds to the smallest two thirds of LSE-quoted companies), but little or no evidence for the other size quartiles (corresponding roughly to the largest one third of LSE-quoted companies). These findings suggest at least two areas for further research.

First, we would encourage replication and extension of this work based on a large sample of small UK companies. This work could usefully present further evidence on the differences in the market's response to interims and finals, and could also explore the issue of survivorship bias more thoroughly. Finally, assuming significant PAD exists that cannot be explained by survivorship considerations alone, it would be interesting to consider the extent to which any 'unexplained' PAD is associated with proxies for analyst interest, transaction costs and trading volume, as suggested by Bhushan (1994).

Second, we note that, contrary to previous US studies, our evidence suggests that PAD is not significant for, roughly, the largest one third of UK companies.[15] It would therefore be of some interest to see a systematic comparison of large US and UK firms.

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[15] The one-third figure comes from the results in Table 7 and our figures on the size distribution of LSE-quoted companies in each of our four size categories.

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Dissemination of Price-sensitive Information and Management of Voluntary Corporate Disclosure

John Holland and Greg Stoner*

Abstract—This paper aims to describe how 27 large UK case companies sought to adapt their City and stock market disclosure policies to cope with the changes brought about by the publication in March 1994 of the Stock Exchange's *Guidance on the Dissemination of Price-sensitive Information*. Legislators and regulators have long sought to define and regulate the corporate decision problem in the price-sensitive information area. This paper employs corporate case interview data to describe models of corporate behaviour and to investigate how the case companies have dealt with this problem area. The paper concludes by (a), considering the effectiveness of regulation in providing a clear boundary for corporate behaviour, and (b), by discussing the relationship between this research and another major field study of corporate disclosure management (Gibbins, Richardson and Waterhouse, 1990), developing the disclosure model that they present.

1. Introduction

This research set out to explore the following questions: how do company executives define and disclose price-sensitive information (PSI); and how do they operate within the uncertain environment of externally-defined standards of behaviour concerning the dissemination of price-sensitive information (PSI)?

These questions are important. UK companies faced a 'year of uncertainty' in 1993–94 as the Stock Exchange produced new guidelines on the dissemination of PSI and as changes in insider dealing law came into effect. The way in which 27 large UK companies dealt with the resulting problems provides considerable insight into a little researched area and this, in turn, is of significance to listed companies worldwide as stock exchanges around the world implement similar regulations. The 'year of uncertainty' was an important social experiment. It provided a unique opportunity to study voluntary corporate disclosure to financial markets in a period of change and of heightened company awareness of disclosure issues.

The contribution to knowledge is threefold. First, a model of how 27 UK companies have dealt with the problem of PSI is outlined. Second, the way in which companies dealt with these new constraints also cast light on how companies manage the larger problem of corporate disclosure to financial markets. Third, this corporate behaviour is compared and contrasted with a similar Canadian disclosure model set in quite different circumstances. This analysis provides insights into alternative, non-financial reporting means of communicating to financial markets.

Section 2 of this paper explores market incentives for companies to disclose PSI and to establish sound management practices for the release of PSI. In Section 3 we explore the new regulatory environment concerning PSI, especially the Stock Exchange's response during the 'year of uncertainty'. In Section 4 we analyse current regulation to identify a regulatory vocabulary of concepts and how regulators use these concepts to define the PSI management problem for a listed company. Research methodology is discussed in Section 5. In Section 6, the company executive interview data are used to examine corporate policy for City and stock market communications. This is the broader decision context for the PSI dissemination problem. In Section 7, the specific problem and decision process is explored through a descriptive model of how companies sought to recognise PSI, define PSI and time its release. Throughout Sections 6 and 7, the case data, in the form of many short quotes, are used to illustrate these models of corporate behaviour. The paper ends by considering the effectiveness of regulation in providing clear concepts and boundaries for corporate behaviour, and by relating this research to another major study of corporate disclosure management (Gibbins, Richardson and Waterhouse, 1990).

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*John Holland and Greg Stoner are at the Department of Accounting and Finance, University of Glasgow. They acknowledge the anonymous referees, participants at the September 1994 Scottish BAA conference at Paisley University, and at the April 1995 BAA conference at the University of the West of England Bristol, and participants in research seminars at the Universities of Glasgow, Stirling and Wales (Bangor). The authors would like to express gratitude to the Chartered Association of Certified Accountants for funding the research project and the case participants for their considerable contribution to the research. Correspondence should be addressed to Professor Holland, Department of Accounting and Finance, University of Glasgow, 67–71 Southpark Avenue, Glasgow G12 8LE. This paper was first submitted in October 1994 and accepted in June 1996.

2. Market incentives for managing PSI disclosures

In this section, market incentives for companies to manage PSI disclosures are briefly outlined. Both market-makers and company outsiders recognise that they might lose to managerial insiders who trade on company PSI and so impose costs on them. These include increases in the cost of capital (share price reduction) and liquidity reduction (Schmidt, 1991):

- Outsiders will pay less for a company's shares compared to a situation where there is no potential for inside information to arise or for insider trading to take place. In extreme conditions they may simply stop holding the company's shares if they think the management insiders who wish to trade with them hold vastly superior information.
- If market-makers do know whether they are dealing with insiders or outsiders, and they think there is potential for insider trading, they will widen their bid-ask spread and conduct fewer trades at the margin.

Market-makers and outsiders may also penalise a company that is prone to make deliberate releases of PSI through its core financial institutions and analyst channels. Such practices, though not intended to lead to insider dealing by a select few (of analysts or core financial institutions), can have these consequences. This insider dealing possibility will also be viewed by non-core outsiders and market-makers as another way by which they might lose, in this case to core financial institutions and analysts as quasi insiders. As such they impose similar costs acting on the company to avoid PSI leaks to insiders or quasi-insiders.

Finally, market-makers and outsiders may penalise a company that has weak internal controls over PSI and is considered generally poor (compared to similar companies) in its communications with the City. This can increase the probability of inadvertent PSI leaks to quasi-insiders, and reduce the credibility of corporate disclosures. This may mean that the public information on the company is of lesser quality than similar companies, and may lead to wider buy-sell spreads and higher risk premiums compared with companies of the same systematic risks but with better City communications.

Hence we can see that, irrespective of the existence of regulation, companies as the ultimate losers have strong market-derived incentives to:

- communicate effectively with the City, made up of all major investors and analysts;
- release PSI promptly and accurately into the public domain or that section that can impose cost;
- avoid PSI release or receipt through private channels;
- avoid internal managerial insider trading; and
- avoid insider trading stemming from inadvertent PSI release to quasi-insiders.

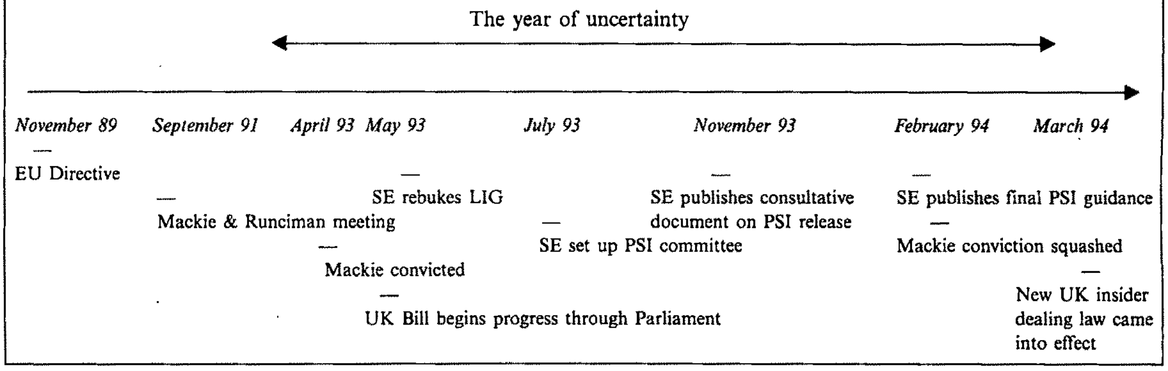
The increase in costs of City communications, of PSI management, and control over quasi-insider and managerial-insider dealing, are likely to be incurred up to the point where they become uneconomic, i.e. up to the point that marginal cost is equal to the marginal reduction in the perceived corporate loss from poor monitoring systems (agency cost of equity). These incentives suggest that corporate investment in City communications, and corporate insider and PSI management mechanisms such as the use of advisers, the use of information technology to provide 'news' and share price data, and other approaches that curtail managerial 'opportunism', will be employed irrespective of whether regulation such as insider dealing law or Stock Exchange rules exist. Once management has made the agency cost calculations and invested in these management systems, it should concentrate on value maximisation.

3. The new regulatory environment and the emergence of insider dealing and PSI regulation

Insider dealing and the release of price-sensitive information are closely associated. The latter may be the precursor to potential and actual insider dealing, and the regulation of PSI dissemination has therefore been intimately linked to insider dealing regulation. Public concern about this potential for insider dealing has led to recent increases in legislation and the development of detailed Stock Exchange guidance for companies. In the past three years a combination of legal decisions, actions by the Stock Exchange and changes in law have created problems for companies, analysts, the press and financial institutions, concerning the release of information by companies. The key chronology of events is as follows:

In September 1991, a meeting took place between Thorold Mackie, analyst at Bell Lawrie, and Peter Runciman, chairman of Shanks McEwan. This was followed by sales of Shanks McEwan's

Figure 1
Chronology of Events


The year of uncertainty
November 89
EU Directive
September 91
Mackie & Runciman meeting
April 93
Mackie convicted
May 93
SE rebukes LIG
UK Bill begins progress through Parliament
July 93
SE set up PSI committee
November 93
SE publishes consultative document on PSI release
February 94
SE publishes final PSI guidance
Mackie conviction squashed
March 94
New UK insider dealing law came into effect

shares by Bell Lawrie clients. Shanks McEwan subsequently made a profit warning. In April 1993, Mackie was convicted for using inside information arising out of this meeting. In February 1994 the Mackie conviction was quashed (Bain 1993 and 1994). On 14 May 1993 the Stock Exchange formally rebuked LIG plc for providing a private profit warning to individual analysts and institutional shareholders (Marckus, 1993).

These events triggered the setting up of a Stock Exchange committee in July 1993 with the task of providing guidance on PSI dissemination. These events also coincided with harmonisation pressures emerging from the EU and have played a role in adapting the Company Securities (Insider Dealing) Act 1985 and section 47 of the Financial Services Act (1986). The Stock Exchange committee's work coincided with the passage of the new law through Parliament, and publication of the guidance was synchronised to coincide with the new law coming into force on 1 March 1994. Part V of the 1993 Criminal Justice Bill came into effect on this date. The principles of previous law remain, in that it is an offence to deal in securities or to encourage others to do so when in possession of inside information. However, the range of the law has now widened to include a wide range of securities (Keenan, 1993).

4. Defining PSI and other regulatory terms

In this section we explore how the regulatory system employs a set of related concepts of information, and uses these to define illegal use of PSI. These concepts will be used to define the PSI problem for companies as a constraint on corporate communications and voluntary disclosures to the City.

Terms such as 'price-sensitive information', 'inside information', 'made public', and 'in the price information', are commonly used and employed in legislation and in regulation.

The 1994 Criminal Justice Act defines price-sensitive information as information which, if made public, would be likely to have a 'significant effect' on the price of shares or other securities. 'Significant effect' is not defined, and this remains a problem for companies, fund managers, analysts and the courts until case law sets a series of clear precedents. Consequently, these groups will face difficulties and some uncertainty as to whether their contacts and information exchanges are within the law (see Rice, 1994 or Keenan, 1993).

In practice, prosecutions in the UK are only sought in clear-cut situations where, for example, the price change has been very large and there is very little room for dispute about 'significant effect'. However, even here there has been great difficulty in proving an offence under criminal law. The US and UK use of the case-by-case approach reflects the iterative nature of learning by the courts and regulators in this field as they strive to find an operational working approach to regulating insider dealing.

The Stock Exchange 1994 *Guidance on the Dissemination of Price-sensitive Information* also makes it clear (p. 2) that is is 'not feasible to define any theoretical percentage movement in a share price which will make a piece of information price-sensitive'. However, the guidance does employ the same definition of price sensitive information as the law. Thus 'price sensitive information will potentially have a significant effect on a company's share price'.

The onus of the 1994 Stock Exchange recommendations is that UK companies as information releasers, and financial institutions and broker analysts, as receivers, must define 'significant effect' and thus PSI according to their own special circumstances. That is, information would have a significant effect on key corporate financial performance variables, such as future earnings or profits, borrowings or capital structure or anything else that could affect the share price. PSI, once defined and identified within the firm, should then be released into the public domain and should not be released through individuals or select groups. However, the Stock Exchange committee explicitly recognised the value to both companies and the market of a dialogue between analysts (broker and investing institution) and the company that builds up a view of a business's potential (p. 5).

Under section 58 of the UK Act, information is 'made public' if it is published (e.g. under Stock Exchange rules), it is in public records, it can be derived from public information, it can be acquired by exercising expertise, or it can be acquired by observation (Keenan, 1993). Finally, the Stock Exchange guidance recommends that 'Companies and their advisers should be aware of the market expectations built into the company's share price'. A company must seek to understand the information that is already in the company's market price.

Thus the interconnected system of legislation, regulation, guidance and surveillance employs a set of legal and practical concepts of inside information, price-sensitive information, made public information, and 'in the price' information.

4.1 Legal and potentially illegal information releases across the boundaries

'Inside information' is a somewhat misleading term denoting the public perception that the primary source of insider dealing information is inside the company. In practice, it is quite legal to trade on non-PSI arising within the company, and it is illegal to trade on PSI whether it arises inside or outside the company.

PSI flows derived from companies, analysts or financial institutions direct into the public domain and then into the market price are legal and, according to the guidance, should be maximised. The release could occur through the Stock Exchange's Company Announcements Office (CAO) or through a widely read publication such as the *Financial Times* (*FT*). PSI thus becomes non-PSI as traders rapidly exploit the publicly available information and the market rapidly and efficiently assimilates it. Investing in technology to access public announcements quickly and to trade instantly is not seen as unfair and is not illegal. There is, however, a requirement on companies (and other parties) not to create a false market in a company's shares and to therefore maximise these flows.

Any information flows of non-PSI, from whatever source, are legitimate. Non-PSI flows from inside the company to the 'made public' domain are encouraged by the Stock Exchange to maximise the potential flow of information to the general trading public and market.

Access to, or possession of, inside (PS or non-PS) information is not in itself a crime. Many insiders such as chairmen or market-makers must possess this information in order to perform their duties within the company or to deliver services to it.

4.2 Defining the PSI problem for companies

The law and regulation define a decision problem for companies to solve. Companies are required, by the legal and regulatory controls, to make judgments how to:

- avoid a false market in the company's shares;
- keep the market and the public informed;
- understand market expectations about the company embodied in the share price;
- deal with PSI issues by identifying internal PSI and communicating it to the market directly;
- avoid release of internal PSI to analysts, financial institutions and the press and thus how to avoid increasing private PSI outside the company;
- manage continuous probing by analysts, press and perhaps financial institutions, concerning internal PSI.

The guidance also encourages companies to communicate non-PSI to analysts, financial institutions and the press.

The objective implied in this externally defined decision model is that company management should actively inform the market (to maximise/optimise the information flow to the market), in order to meet the regulatory requirements, subject to adhering to the constraints imposed by the law, the Stock Exchange listing rules and its guidance on PSI dissemination.

The Stock Exchange requirement to keep the market informed and to avoid false markets is considered central to the market's efficient functioning and to the maintenance of confidence. However, 'ensuring that information which emanates from the company, its advisers or agents is given to the market as a whole and is sufficient and not inaccurate or misleading' (section 6 of the guidance), poses as many definitional difficulties as 'price sensitivity'. The vagueness here may allow companies considerable room for manoeuvre. The potential vested interests of companies and corporate management may conflict with the Stock Exchange's 'false market' and PSI release objectives, resulting in an objective to minimise certain forms of potentially harmful information releases to the market, subject to an additional constraint: to adequately inform the market, or to avoid the charge of creating a false market.

In Sections 5 and 6 of this paper we will observe that the case companies saw their PSI decision problem as part of a larger corporate communications decision policy, which was driven by strategy and corporate financing policy, and not by regulation or the ideals of fair markets encapsulated within them. They also perceived a broader set of constraints on their communication policy other than the legal and Stock Exchange guidance constraints.

In particular, a common theme in the majority of the case interviews indicated that the key questions for their companies were: 'How could they deal with the sources of legal, regulatory, conceptual, and price impact uncertainty in the PSI management problem?' and 'How could this problem be dealt with as part of their broader financing and City communications problems?'

These questions are closely related to this paper's research questions (defined in Section 1) and indicate the significance of the research questions for quoted UK companies.

The uncertainty faced by the case companies in dealing with these two questions led them to construct internal and external (boundary) mechanisms with a high degree of reponsiveness (Section 6). The mechanisms were then used in a flexible way in a continuous City communications and PSI management decision process (Section 7).

5. Research methodology

As we were interested in the way the company executives defined and dealt with PSI issues, it was important to use a methodology that was focused on the individual and that would minimise the imposition of the researchers' priors on the subjects. To this end the data for analysis was collected via the use of general questions in a semi-structured interview context. Detailed questions on PSI were not posed, and it was left to the interviewees to raise these issues. Neutral questions posed in a climate of PSI uncertainty and debate were relied on to raise the PSI issues and to generate novel company data independent of the researchers' prior views. The method adopted was to use a non-invasive naturalistic interview method to focus on the interviewees' reflected verbalised thoughts, thereby providing valuable insights into the subjective understanding of the individuals' life worlds.

Qualitative research methods such as that used here allow rich insight into new research fields and provide the basis for the establishment of understandings of the interpersonal and social construction of everyday decisions and action (for example, see Easterby-Smith et al., 1991; Scapens, 1990; Hopwood, 1983; Morgan and Smircich, 1980; Tomkins and Groves, 1983).

We undertook a series of interviews with 27 large UK listed companies. Details of the companies are tabled in Appendix 1, providing contextual information for case quotations. The company sample covers a wide range of *FT* sectors and thus industries. Twenty-two companies were in the FTSE 100 and another five were in the FTSE 100 to 200 range. The subjects included 14 participants in the chief executive or finance director role, and 13 participants in the corporate communications or investor relations role, indicating how the locus of the City communications decision task varies across UK companies. Access was established in 27 companies out of 33 approached, a success rate of 82%.

The interviews were conducted during the period August 1993 to March 1994, and covered a large part of the 'year of uncertainty' concerning PSI issues in the UK, a period of extensive public debate. Case participants were concerned about the PSI debate and were developing their own approaches to its management.

The initial contact was by telephone, discussing the general aim of the research programme of which this study is a part. A follow-up letter was sent providing further details and the core interview questions. The subject of PSI was highly topical at the time and of strong interest to managers.

The interview questions were semi-structured and designed to allow the participants to interpret and describe the phenomena in their own way. The research letter and research questions were designed by surveying the literature on qualitative research, and by adapting interview instruments published in this literature (Bryman, 1988; Buchanan et al., 1988; Buchanan, 1993). The questions focused on the broad nature of links between companies, financial institutions and the market, as well as the flow of information through these links and directly to the market. This was the limit of the structure imposed on the interview process. Other similar interviews by the authors had indicated that this approach would create a sufficient degree of structure to ensure that the research question would be addressed while minimising the risk of presensitisation and biased interview responses.

Each participant had the generalised interview questions for at least a month before the interview. All were well prepared to explain their own views in considerable detail. However, there was little opportunity for rehearsal of answers relating to PSI, as the questions were deliberately general and designed to capture data on several related issues. Thus the interviewer's main roles were to record these views and to empathise with interviewees so that a trusting, open atmosphere prevailed. During most of each interview the participants were asked to talk freely about the questions and to discuss them from their own experiences. Their commentary was not disrupted. It was only in the last few minutes of each one and a half or two hour interview that specific questions were posed, and then only if a major PSI issue had been omitted. The research design appeared to work very well. Most participants were very forthcoming and provided considerable breadth of coverage in their views on PSI, reflecting the issue's topicality and the semi-structured nature of the questions.

The case data are used in the research report in two ways. First, as the basis for developing corporate behaviour models concerning disclosure of PSI and non-PSI. Second, to provide short cases and quotes to enliven and illustrate these concepts and corporate decision processes. The quotes are identified by case numbers shown in the appendix. These corporate behaviour models have been identified through a Glaser and Strauss (1967) 'grounded theory' approach to the case data. A seven-stage approach has been adopted to sifting through and processing the large volume of case data (Easterby-Smith et al., 1991). These stages include case familiarisation, reflection on the contents, conceptualisation, cataloguing of concepts, recoding, linking and re-evaluation. During these stages we compared the interview responses of the various subjects to identify common themes and relationships that indicated inter-subjective understandings of PSI and problems associated with its definition and dissemination.

In order to internally validate the research interpretations, the co-researchers reviewed the interview data and discussed differences of interpretation and analysis. Full independent coding and analysis of the interview data has not been undertaken. Though independent analysis would increase the internal validity of the research findings, the investment entailed was not deemed to be practical, given the constraints of the research environment. We recognise this methodological weakness, which is reflected in the tentative nature of the research claims made.

In terms of the generalisations that can be drawn from this research, it is important to recognise that it is problematic to generalise beyond the case subjects. Hence, despite the sample coverage, we do not claim that the research is representative of all large UK companies. The findings do, however, form a basis for further research of this phenomenon. Further details of, and support for, the methodology adopted are set out in Stoner and Holland (1996).

Acquiring this degree of access to key corporate decision-makers is rare in financial management research. This research is unique in the field of inside information and the dissemination of PSI because of the access obtained and our focus on corporate decision processes in the little observed and little understood interactions between companies, financial institutions and analysts. The research method has provided an illuminating study of how the corporate PSI and non-PSI dissemination process is conducted at the level of individual companies.

6. Corporate communications to the market

In this section we use the case data to explore how the case companies set up structures within the company and at the boundary between the company and the market to deal with corporate market communications and the uncertainty inherent in them. Internal structures involved the formulation of general communications policies and the setting up of responsive systems of tailored decision processes, investor relations functions and internal controls over PSI. At the corporate/market boundary these structures involved the setting up of a network of analyst, financial institution and press contacts. These micro structures were found to be important to the case companies, since they formed the context and the means for them to handle their PSI management problem.

The remainder of this section outlines the internal and boundary structures that make up corporate PSI response systems.

6.1. General communications policy and the setting up of an internal responsive system

The complex nature of the PSI problem led the case companies to recognise that they were dealing with many interrelated grey or problematic areas of judgment. For example:

> '...formal announcements, the background information, the rules about not talking about forecasts, the guidance on talking to brokers about their research reports, the tight internal controls, the responsiveness to events—these all combine to provide us with some overall system in which we can make some educated guesses and informed judgments about what is price-sensitive information and what we should say under each specific circumstance. It is very difficult to identify general rules....' [9]

Other subjects also indicated that they could not always define PSI before new events and they could not accurately predict the market price reaction to some unanticipated new categories of events or to company-supplied information. Therefore they sought to set up a corporate system that created corporate responsiveness to new PSI events, to minimise the inadvertent corporate release of PSI and to meet legal requirements.

The structures are commonly identified as part of a proactive City communications strategy, not merely responsive in nature.

> 'The combination of these price-sensitive information categories, rules, internal con-

> trols and information systems constitute both a defensive and positive system... defensive in the sense it can be used to minimise the error of the dissemination of price-sensitive information. It is more useful to see it as a positive system which maximises information flows to the market.' [23]

The internal responsive system typically included the following components.

6.1.1. Internal decision processes tailored to the communications and PSI problems. All the case companies recognised that they had to respond to PSI situations at the highest level.

> 'In general, it's part of a general communication policy. We have an investor relations steering committee...a high-powered committee...In this way we keep all senior executives involved in the communications with the City...and reflects the significance of the company being in the news...and the company having to respond to the situation at the highest level...to ensure that communications is a key part of its strategy.' [21]

Most of the case companies made PSI part of a general communication policy, and tailored their internal corporate decision processes to deal with the communication and PSI problems. The majority also addressed City communication issues as part of a regular strategic analysis, designing decision processes to deal with unanticipated PSI events. Case 16 provides an indication of this aspect:

> 'We now have a system whereby the executive directors are directly involved with communications strategy...Every quarter year they put communications on the agenda in their meetings and this is the sole item on the agenda...The main function of the IR staff is "managing the conversation"...As a result, we now have been able to reposition the image of the company in the marketplace.' [16]

6.1.2. Setting up an investors' relation function with supporting IT systems. Thirteen out of 27 of the companies had set up a communication function, to implement policy towards financial institutions and analysts and to deal with potential PSI flows, including a formal City or investor relations communication component. In all the other 14 cases these functions were subsumed in executive roles, normally shared between the chief executive and the finance director.

> 'External management of price-sensitive information is done through two related roles—one a semi-finance function ...[c]ompetence here is absolutely essential. The second...is a semi-public affairs function or communications function...promoting the image of the company in financial markets and ensuring that image is well understood and accurately reflects the underlying reality of the firm. Both kinds of skills are necessary to control the release of PSI.' [9]

In 20 of the 22 FTSE 100 companies, this function involved an extensive investment in information technology, for example:

> 'We use the Newsedge system. This system tracks major news reports around the world...The software screens out information into certain categories...anything dealing with us will be screened out, anything dealing with our competition will be screened out and then there will be special categories for priority issues...Information will flash on the screen when the news event occurs.' [23]

6.1.3. Internal controls over PSI. The establishment of internal controls on PSI flow were raised by most subjects, including:

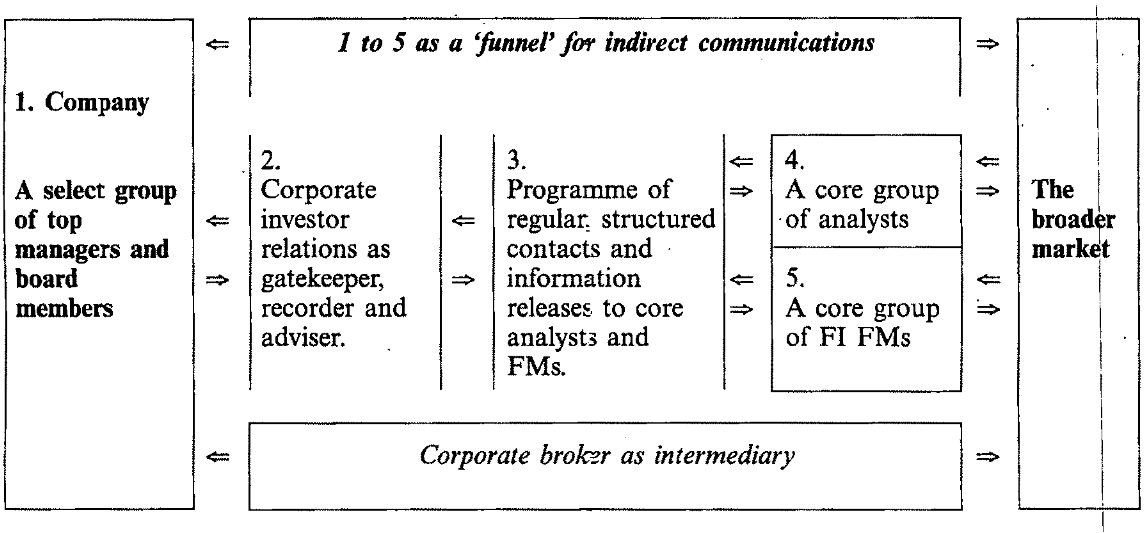
> 'A point to be recognised here is that there is only a very small circle of people here at headquarters involved in making these decisions...This means that we have very short lines of communication and can come to a decision fairly quickly and we hope fairly effectively. All of these conditions... minimise the risks of release of price-sensitive information.' [10]

> 'Another way of controlling price-sensitive information release is to have formal categories of people who have access, internal access, to PSI...These individuals are formally identified and they have to sign our equivalent of the Official Secrets Act. This includes the secretaries...and the board of directors... We therefore have a very small number of people who are recognised on an "allowed to know" or "need to know" basis.' [23]

> '...all area management have been given a copy of the price sensitive guidelines from the Stock Exchange and on the insider dealing rules. We also give them seminars...We are also just completing a code of conduct on insider dealing...from a common base from the US and UK law. We expect to adopt the toughest parts of each law...We also take a record of our discussions about what price-sensitive information is.' [25]

The following quote provides a detailed illustration of how one of the case companies was developing internal responsiveness to analysts' and others' questions:

Figure 2
Corporate to Market Communication Structures


1 to 5 as a 'funnel' for indirect communications
1. Company
A select group of top managers and board members
2. Corporate investor relations as gatekeeper, recorder and adviser.
3. Programme of regular structured contacts and information releases to core analysts and FMs.
4. A core group of analysts
5. A core group of FI FMs
The broader market
Corporate broker as intermediary

> 'We...develop a very carefully scripted set of questions and answers. However, you also get questions that will stop you in midstream. One of the reasons we use advisers is to spot many of these questions in advance. When we see any event, we prepare up to 30 or 40 questions and answers in a carefully prepared and scripted form. [which] is used by our [group] executive committee...We therefore ensure that they all talk the same language.
>
> 'The scripted questions and answers are also used by lower level managers when speaking to their staff about results...We also tell them very clearly that if mistakes are made or if a problem activity occurs or insider dealing occurs, they are culpable as individuals.' [25]

The identified controls were grouped into four broad categories, the last of which has a significant and explicit impact on the boundary as well as on the internal flows of information:

- Small HQ group 'in the know' and short HQ communication lines with rapid internal decisions on PSI.
- Restricted 'need to know' internal lists, 'Official Secrets' contract, safes, topics not discussed, control over internal ability to trade before release of PSI and codes of conduct on personal responsibility.
- Tight internal control over hierarchical aggregation of management accounting and planning information.
- Detailed question and answer scripts to respond effectively to external questions.

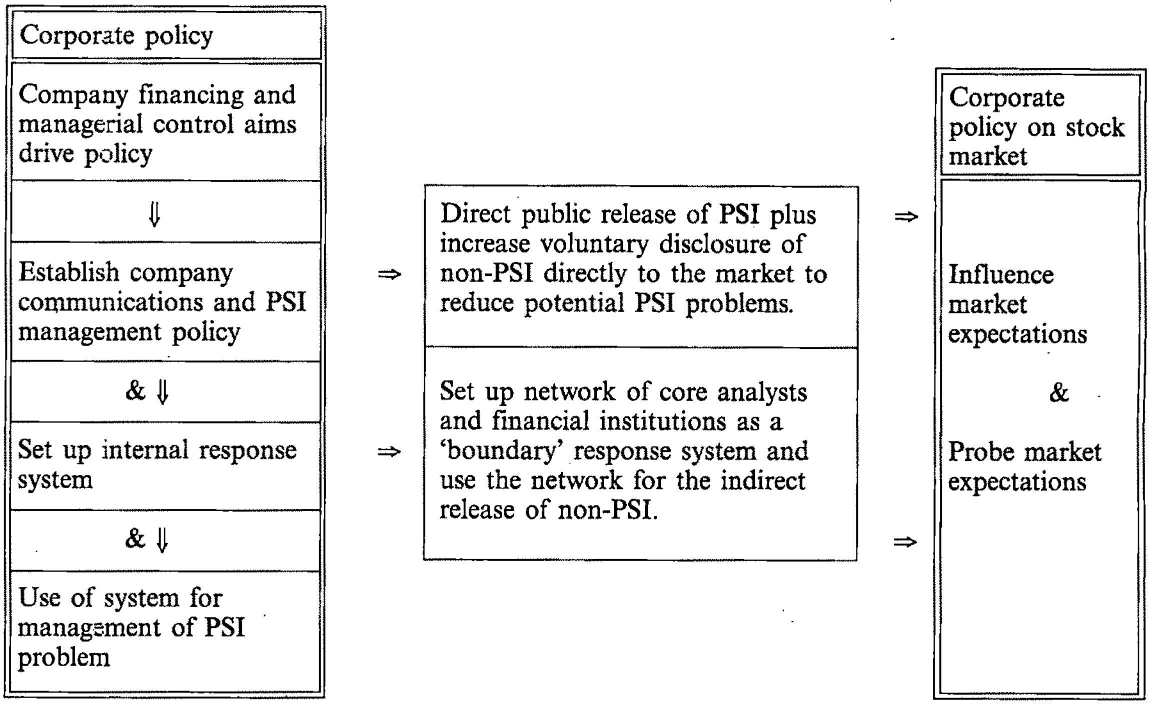
6.2. The network of contacts with financial institutions and analysts as a boundary response system

A part-designed and part-evolved network of contacts with financial institutions and analysts was identified in all the cases as a major means of communication with the stock market and for the probing for company-specific market expectations information. The policy of these case companies was to set up corporate communication channels with a network of analyst, financial institutions and press contacts. The companies made extensive use of these close relationships to control the flow of non-PSI company information, to avoid an accidental or inadvertent release of PSI and to manage probing questions from analysts and others concerning PSI. When information was judged to be clearly non-PSI then the case companies felt they could legitimately communicate this through their restricted, semi-closed network of core institutions, core analysts and close press contacts. The typical information network, or channel, structure for communications with market participants is illustrated in Figure 2.

A key ingredient identified in the data was to establish co-operative relationships with core financial institutions and similar company relationships with a core group of broker analysts. Typically, the core institutions constituted the top 10 to 20 institutional investors in the company, especially those with stable stakeholding policies. A similar group of the most influential analysts following the company were courted.

In the bulk of cases, it was well understood (on both sides) that these channels should not be used for PSI release such as the 'steering of analysts'

Figure 3
Topology of Corporate Communication Policy Micro Structures


Corporate policy
Company financing and managerial control aims drive policy
⇓
Establish company communications and PSI management policy
& ⇓
Set up internal response system
& ⇓
Use of system for management of PSI problem
⇒
Direct public release of PSI plus increase voluntary disclosure of non-PSI directly to the market to reduce potential PSI problems.
⇒
Set up network of core analysts and financial institutions as a 'boundary' response system and use the network for the indirect release of non-PSI.
⇒
⇒
Corporate policy on stock market
Influence market expectations
&
Probe market expectations

forecasts. Exceptions to this were observed as a small number of companies sought to use their restricted, semi-closed network of core financial institutions, core analysts and close press contacts, to leak, control the flow, or modify the impact of PSI release.

The network of links, the communication funnel, the core analysts and institutions, and the corporate broker as described in Figure 2 formed an integrated communication structure. This was used to alter states of knowledge in the core analysts and institutions, and influence and probe market expectations concerning the company. Specifically, the aim was to invest resources in pushing institutions and analysts up a company learning curve. The company hoped to establish high understanding of the company in its core institutions and analyst. These influential groups were able to quickly assess new events in informed ways, and to provide a better informed influence in the market. The (non-PSI) information released here was less event-specific than that arising in most PSI situations. It was more general, more impressionistic, and often fragmented in character. It focused on the longer term rather than on next period earnings. Financial institutions and broker analysts reciprocated with information on institutional investing policy, on the industry and the economy. In addition, three of the case companies saw their network as a way of creating more PSI outside the company, and thus reducing the company PSI management problem. This would be clearly illegal if it involved event-specific information likely to have a significant effect on the share price. It would be in a grey area if it involved fragments of information about ill-defined events, and its aim was to allow the analysts and fund managers to use this to continuously learn about the company and thus create their own PSI outside of the company.

6.3. A map or topology of the micro structures

In Figure 3, we have summarised much of the data on micro structures identified in the cases. The diagram provides a simple map or topology of the internal and boundary structures and their links to the stock market. It illustrates, in schematic form, how the case companies tried to solve their general problems of communicating with the market directly through public announcements and indirectly through their (semi) closed network of core financial institutions, analysts and press contacts. The problem of PSI management was conceived as part of this overall communication policy, and both PSI management and corporate communications policy were driven by financing, control and strategic needs.

The schematic model in Figure 3 represents company policies and behaviour patterns that repeated themselves across the cases. These components are based on each case company's attempts to solve their general communication problem and their associated PSI dissemination decision problem. The figure therefore summarises the data in the form of a simple model of corporate 'best practice' as identified by the consensus from the case companies, though considerable variety was present within this overall framework. It emphasises the purposeful, dynamic nature of this aspect of corporate decision-making and illustrates how the case companies actively sought to influence their core financial institutions, analysts and the market.

7. Corporate use of the responsive system and managing the PSI problem: a process model

A persistent theme raised by the corporate executives in the cases involved the relationships between corporate news (internally and externally generated) and share price movements. It is evident that they were constantly identifying new internal and external events likely to impinge on corporate performance and share price, and that they were in a continual state of readiness to deal with events and PSI problems. They had to be able to quickly recognise and define PSI problems, and to manage the release of PSI and non-PSI, through public and private channels. They also expressed the need for continual learning in their PSI management roles.

This PSI identification and release decision process was also used to clarify whether corporate or external insiders could or could not trade, having been in receipt of inside information. The law is quite clear here. In principal, company insiders—such as directors or managers—or external insiders—such as close institutional investors—cannot trade on information considered to be price sensitive (or in the US, 'material'). In contrast, both company and external insiders can continue to trade when new information is not PSI.

A high degree of commonality was identifiable within the case data with regard to the structural stages and utilisation of established corporate response and PSI management systems. In broad terms, the three interrelated but identifiable steps are:

- The identification of internal and external events that may include or generate PSI.
- The making of judgments as to whether these events created PSI or non-PSI within and/or outside the company.
- Deciding if, how and when information would be released.

These three stages are explored in the following subsections before summarising the overall process in a simple model.

7.1. *The use of the responsive system to identify events with PSI implications*

7.1.1. Use of IT monitoring systems to observe new events, news flows, and price changes. In 20 out of 22 of the FTSE 100 company cases, screen-based news information systems were used to filter out company and important event news and to signal this to managers.

> '[our news system] allows us to keep one step ahead of the brokers' analysts. We are ready to respond to their questions. This gives us some time to think about how we might answer their questions. This gives us an edge in controlling the release of price sensitive information. It also gives us an opportunity to respond sensibly and to correct errors or misreporting and to highlight the positive side of the news.' [23]

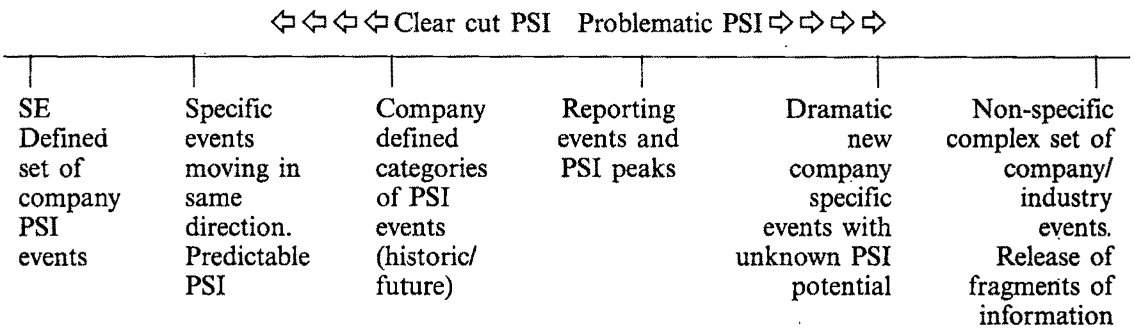
Information systems were also almost universally used to observe share price changes and daily trading volumes. The simultaneous information flows allowed companies to gain insight into what kind of information seemed to move their share price. The case data shows that this type of real-time monitoring improved their judgment over time as to what information was likely to be PSI.

7.1.2. Event structure and PSI definition. The case companies identified different types of internal and external events with different potential PSI implications. Figure 4 is a synthesis of the categorisations expressed within the data, showing the continuum between the definition of PSI as problematic, requiring considerable managerial judgment, and as clear-cut, with little room for corporate discretion. The case data indicated that classification was useful as corporate guides for considering the nature of PSI dissemination problems, for deciding on appropriate responses and for the identification of potentially important events.

Section 10 of the Stock Exchange guidance makes it clear that the more specific the information, the greater the risk of its being price-sensitive. The Listing Rules indicate many specific events that have to be announced to the market because they may trigger PSI, including dividend announcements, board appointments or departures and profit warnings. The case companies recognised the Stock Exchange categories as significant sources of PSI and understood the regulatory requirement to announce these events to the market.

The case companies also identified other corporate event categories that had to be announced

Figure 4
Event Types and PSI Definition Clarity


⇦⇦⇦⇦ Clear cut PSI
Problematic PSI ⇨⇨⇨⇨
SE Defined set of company PSI events
Specific events moving in same direction. Predictable PSI
Company defined categories of PSI events (historic/ future)
Reporting events and PSI peaks
Dramatic new company specific events with unknown PSI potential
Non-specific complex set of company/ industry events. Release of fragments of information

because of the high likelihood they would have a significant effect on share prices. Among the cases, the following were mentioned:

- Corporate actions (arranged press meetings) that hint at potential PSI announcements.
- Confidential corporate decisions such as pension fund changes.
- Any major company event such as restructuring, costs of restructuring or significant new order.
- The delay of the launch of a new product.
- Major problems in technologically intensive product development programmes.
- A move into new areas of business or plant closures.
- The first part of a large investment programme, expenditure and timing.
- New technology and R&D investments.
- Major problems or negotiations with regulatory bodies.

Recurring event categories could be identified in which PSI was likely to occur. However, even here the definition of PSI and the identification of triggering events depended on economic and other conditions.

The case executives argued that they had specialised skills in identifying and defining new events particular to their company, industry and markets, before financial markets could do so. They also claimed that they had inside information about those events that were anticipated by the markets and that this led to another source of PSI management problems. In addition, PSI problems were thought to surround unanticipated events, which markets could not contain information about, as such events arose at random.

7.1.3. The use of PSI event categorisation. The following case illustrates how the case and other companies used PSI event categories:

> 'We use simple categories of what is price sensitive information. Although we are well aware that these can change as time goes by as the business changes. These would include:
>
> • Trends in bad debt charges...very price sensitive in the recession...less important in a boom.
>
> • A forecast of anything in the profit and loss account. If the analyst...talk[s] about their forecast, we say, 'It is your forecast, no comment'.
>
> • Anything to do with bank expenses, as the cost ratio is critically important....
>
> The categories are helpful in avoiding difficulties with price sensitivity. They are no guarantee that information will be released and will ultimately prove to be price sensitive. This is one of the most difficult parts of this job. To some extent we are living on a razor edge with this one.' [8]

Case executives were sensitive to the emergence of PSI issues around key periods, for example the financial reporting calendar, public announcements and press releases. Recognising peaks of PSI:

> 'Price sensitivity is at its height in the close season, one month before the quarterly report, or two months before the half-yearly report. The level of price sensitivity drops during the year.' [9]

Price sensitivity was also often about internal events that trigger flows of information.

> 'Price sensitivity is about internal flows of information. In particular, the management accounting information...from our subsidiary businesses...and the planning process that occurs within the group. We therefore have a problem of internal management of price sensitivity as well as the external management problem...We have to be very careful in controlling [the information] feed into the central headquarters from the sub-

> sidiary business. There is also the planning process... at headquarters...Clearly this is very price sensitive.' [9]

7.2. Problems of defining PSI

The problem of defining PSI was evidently very difficult for the corporate executives and required simultaneous solutions to a set of related problems:

- What are market expectations?
- Are they thought correct relative to company information?
- What size of price movement could occur and is it likely to be significant?

The case companies made extensive use of their advisers to help them deal with these questions and to make their PSI judgments.

7.2.1. Probing market expectations about the company. According to the Stock Exchange guidance (para. 15 p. 8), market expectations about a company are manifest in the share price, and its volatility, both set in prevailing market conditions. These expectations are about measurable, tangible forecasts such as earnings and also about less tangible expectations concerning the coherence of strategy, quality of management and succession policy. The case companies sought to understand these market expectations so that they could assess whether new events would alter these expectations in a significant way. Thus they could assess whether information about the events was likely to be price-sensitive.

If a case company released information that was in line with market expectations, then there was thought to be no PSI problem. The problems here, as expressed in the cases, were where the company was not too sure what these market expectations were. Thus the case companies sought to understand these expectations to help them manage the PSI process. In a small number of cases they sought to arrange market expectations so that they could meet or achieve them. In a majority of the cases, the stated objective was not to change market expectations but just to provide a much fuller information background to the existing set of expectations.

The case companies probed their company's market expectations in a variety of ways. In the bulk of case companies, this involved the use of the company broker, or of equity salesmen, broker analysts and other advisers, to assess if the event-specific information was already in the price or was likely on release to create 'significant' price changes. In some cases the companies purchased consensus analysts' forecasts of earnings and financial results. In other cases the practice was to phone around to collect each key analyst's forecast. In all cases explicit attempts were being made to discover the short to medium market expectations likely to be behind the existing stock price. In tandem with this, the case companies all established policies on commenting on, or in a small number of cases, steering brokers' forecasts and hopefully market expectations, as well as policies on 'correcting' broker's research reports. For example, a common policy was to only discuss consensus analyst views and to never discuss the company's own forecasts.

In addition, the regular one-to-one meetings with core investing financial institutions were used to probe their longer-term expectations concerning corporate strategy, competitive changes, financial performance, management quality and succession policy, and many other intangible, difficult to measure aspects of expectations. Thus the expectations of key investors were used as a proxy for the longer-term expectations built into the market price. Market expectations were also probed by observing institutional shareholder movements. The institutional investors were then asked what information (if any) prompted them to make a major sale or stock purchase. The case companies also periodically surveyed (monthly, quarterly) brokers' salesmen and analysts to see how they viewed the company. The companies were trying to find out from them the overall sentiment in the market to the sector as well as their views on the company.

7.2.2. The role of advisers in defining PSI and in the timing of PSI release. New (internal and external), unanticipated event categories with potential PSI implications were discussed with legal and financial PR advisers to judge if they were likely to produce PSI. In over a third of the cases, if a known or a new event category was thought to have internal PSI implications, a detailed scripted response, including up to 40 potential questions and answers, was prepared and circulated around those executives with responsibility for City contact.

The role of advisers was widespread within many of the case companies, typified by the subject who stated:

> 'We have a general approach to trying to figure out what is price-sensitive information. We work with our advisers about price sensitive information issues. In the case of a major announcement we call them in and discuss the whole matter in detail, and the implications for the market of the announcement. This keeps us on the straight and narrow. It avoids error on price-sensitive information and avoids us breaking the law. We cannot afford a case like LIG...We have too high a profile in the financial information business.
>
> 'We spend a lot of time between our finance advisers and our legal advisers on both

> our company and in the brokers and the merchant bankers trying to clarify exactly what the position is. As a result of these in-depth discussions we come to an agreement as to what is the best way of representing an issue in an announcement.' [25]

7.2.3. Problematic PSI questions. Despite all of the above approaches, the case companies still faced major problems when trying to define PSI. A problematic question that pervaded the interviewees' responses was: what price change is significant? It is evident that companies even found it difficult ex ante to determine whether the market would view a release of information as good or bad news. Thus it was very difficult to judge if the information was PSI, especially when a company released information in parallel with other releases or events—a common problem.

> 'In terms of making judgments about the dissemination of price-sensitive information, in general we will reveal information if we believe it to be price-sensitive. The Stock Exchange did not define what was price-sensitive in its recent guidelines and *nor could they*. They could not predict how the market will react to a specific information release... It's extremely difficult to know what is going on [in the market]...we see a change in the stock price. What caused the change? The first set of events, the second set of events, of our release of information? It's very difficult to know which it was.' [27]

Once PSI was defined and understood with respect to a particular event or set of events, the generally accepted rule was to release it through public channels to the stock market and the public domain. The major issue remaining here was the timing of the release.

7.3. The timing of external information releases

The following quotation from the data is illustrative of a latent attitude towards the timing of information releases.

> 'If we think information is material or price-sensitive then we would normally seek to announce this as soon as possible. However, this is dependent upon several factors. The timing of release is thought about very closely to ensure that if possible we exploit our position relative to competitors...We try to avoid a false market or volatile prices in our shares. We are trying to make sure that we are getting the maximum value out of the information for our shareholders before it is released. We are to some extent hoping we can do something about bad news before it occurs.' [7]

The initial comment shows the desire to comply with the Stock Exchange guidance, although there are clear indications that corporate considerations take effect at the margin with respect to the timing of release. However, the overriding 'need' to disclose is recognised.

> 'If we are in any doubt that the information is material or price-sensitive, then we think we should announce it.' [7]

Further, the data suggest that some of the case companies recognised the potential for reputational costs by being less than candid with bad news (Skinner, 1994), both through timing of release and the preparation of scripted responses.

> 'You must remember we have a lot of stakeholders in the business and our communications policy is out to these stakeholders including employees...Clearly there is the possibility of information leaking...before the announcement, especially if you think that analysts use our pubs quite often...This is particularly important with our senior managers, who might bump into analysts in the City.' [16]

This quote vividly illustrates the potential importance of less formal communications channels, not only because of their potential effect on the market but also because of the difficulty of controlling them. The perceived importance of personal contacts and trust within the City add importance to these less formal communication channels.

Finally, three very large multinational companies within the sample faced the problem of which market to release information to, indicating the pragmatic delay of information release and a reliance on rapid transmission of information between three centres, and acknowledging market differences.

> 'We have to slightly alter the message that we issue in different parts of the world...We issue an announcement in three cities simultaneously: London, New York, Tokyo...this ensures that the announcements are seen as coming out on an equal playing field.' [27]

7.4. A summary diagram for PSI decision process

Figure 5 summarises much of the case data on the PSI event identification, definition and information release process. The diagram illustrates how, once set up, the PSI response system provided the means to pursue the positive objective of communicating as much information as possible to the market as well as dealing with unanticipated internal and external events with PSI implications. The relationship between this process and the broader micro structure of corporate/market communications (Figure 3) are also indicated.

The dynamic, continuous nature of the corporate PSI management problem is indicated. This is in sharp contrast to the Stock Exchange's guidance and legal definitions of the problem that emphasise behavioural boundaries and form a relatively static, if unclear, set of constraints around the corporate PSI management problem. The figure also reflects the iterative nature of learning by the case companies (especially between stages 1 and 2) as they, like the courts and regulators, sought to find an operational working approach to (self) regulating the release of PSI and to avoid criminal acts such as insider dealing.

Interpreting the process illustrated in Figure 5 from the perspective of finance theory is instructive. The PSI management decision process has some similarities to the well-established and classic design of event studies in finance and financial reporting. Both event study and PSI management approaches involve identifying: events, firm-specific information generated by the event, the share price or return without the event information, the time the markets receive the information, the impact of the information on share prices, and an assessment of whether the share price impact is significant relative to a benchmark.

The case managers did not, however, employ conventional finance theory measures of 'significant' price change. In a CAPM context, 'abnormal returns', measured in relation to the returns predicted from the company's 'normal' or historic Beta, are used to indicate that information released had significant market information content. The PSI problem for companies is one of trying to identify which events might or might not produce 'significant' share price changes *before the event.* The abnormal return approach with its focus on the *after the event* impact of information cannot therefore be directly employed in PSI problems at the corporate level.

In practice, companies saw the information release and receipt management problem as an ex ante problem, concerned with the potential impact of the information on share prices, the chances of this exceeding some ambiguous social or legal norms of significant price impact, and the possibility of public rebuke and prosecution. Further, the event study technique is not likely to be of much use for a stream of fragmented, difficult to define events. However, the case companies did develop a feedback mechanism to help here by continuously monitoring such events, their associated news flows and share price changes. The IT systems employed allowed them to learn the probable links between events, information releases and share price changes, and thereby to establish event categories for future use.

The company case participants were, by implication, using ideas of informational efficiency. They assumed that PSI, once released, would immediately be included in the public domain information set and be rapidly reflected in share prices (semi-strong form). Also, managers appeared to believe that the management of PSI did include release timing possibilities, implicitly accepting that markets are not strong-form efficient.

Once non-PSI is identified, the company is free to communicate this to financial institutions and analysts. Dorsman and Ruiter (1994) argue that the rationale for the extensive corporate communications to financial markets (Section 6) lies in estimation risk, an asset risk pricing factor that focuses on the differences in availability and reliability of information between companies. Companies that increase the quality, reliability and availability of corporate information in the public domain can reduce this estimation risk, and thus drive the market price towards its 'full information set' value.

8. Concluding themes and issues

An exploratory paper of this type inevitably raises many questions. In terms of communications and disclosure, the themes identified in the data raise the following concerns:

- The limitations of regulation in providing clear concepts and boundaries for corporate behaviour when communicating with the City.
- How the research relates to Gibbins, Richardson and Waterhouse's (1990) major field study on voluntary corporate disclosure.

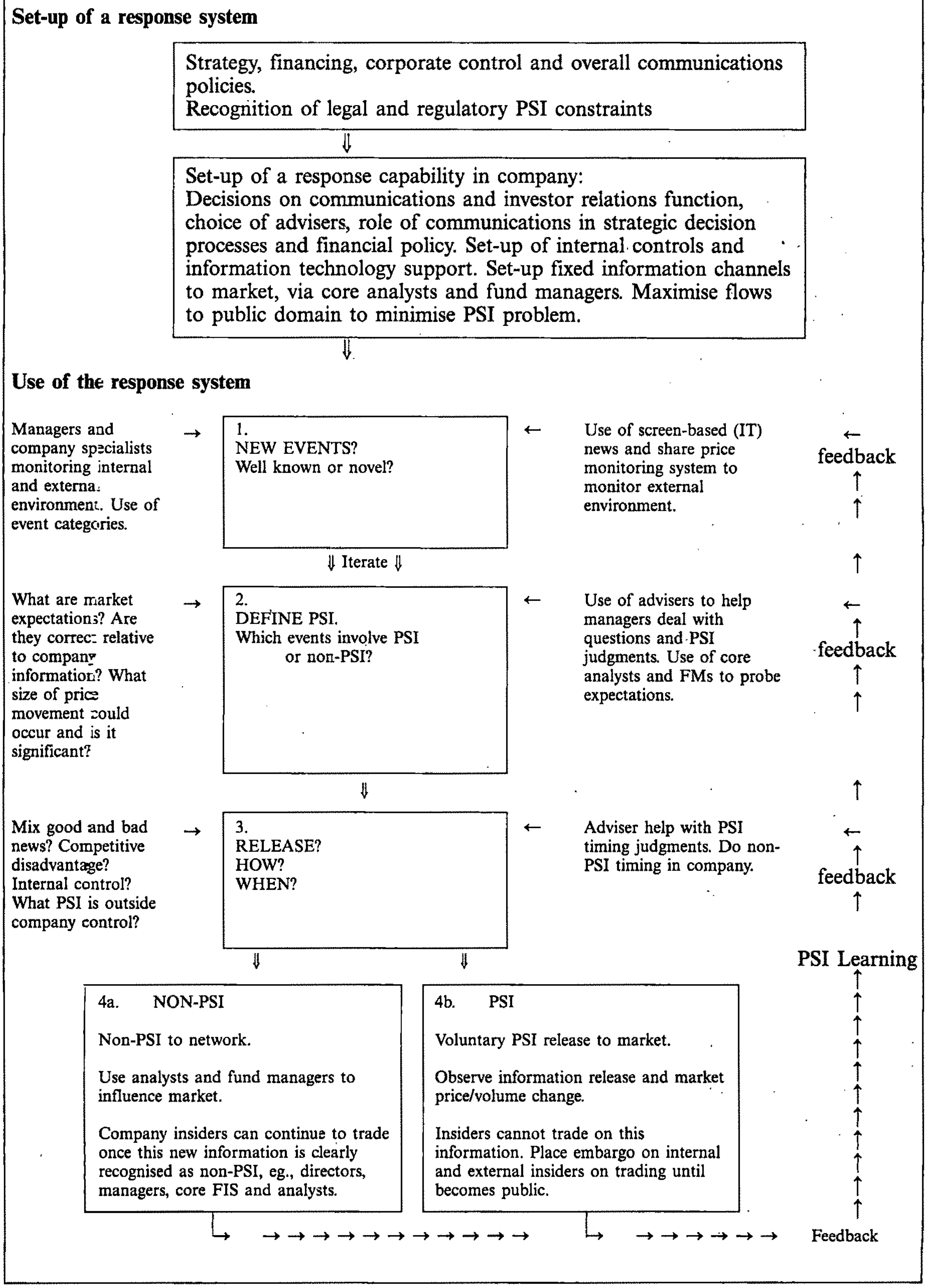
8.1 Limitations of the regulatory context

An oft noted difficulty the interviewees experienced is illustrated by the following quotation:

> 'We do not use the share price...or the share price changes as an objective of investor relations. We think there are so many things changing this that we can't do much about it. Some information appears to be price-sensitive, but there is no change in the price when it comes out. We therefore cannot be sure that the information we released...has caused the observed price change. We...do not seek to control something we cannot control. We...do not debate what is price-sensitive and what is not price-sensitive information. We do discuss what we will say rather than trying to define price-sensitive information...We try to be consistent within these boundaries and try to stay within the law, of course.' [24]

The main story here is that the case interviewees clearly found the regulatory concepts less clear-cut

Figure 5
The PSI Decision Process


Set-up of a response system
Strategy, financing, corporate control and overall communications policies.
Recognition of legal and regulatory PSI constraints
Set-up of a response capability in company:
Decisions on communications and investor relations function, choice of advisers, role of communications in strategic decision processes and financial policy. Set-up of internal controls and information technology support. Set-up fixed information channels to market, via core analysts and fund managers. Maximise flows to public domain to minimise PSI problem.
Use of the response system
Managers and company specialists monitoring internal and external environment. Use of event categories.
1.
NEW EVENTS?
Well known or novel?
Use of screen-based (IT) news and share price monitoring system to monitor external environment.
feedback
Iterate
What are market expectations? Are they correct relative to company information? What size of price movement could occur and is it significant?
2.
DEFINE PSI.
Which events involve PSI or non-PSI?
Use of advisers to help managers deal with questions and PSI judgments. Use of core analysts and FMs to probe expectations.
feedback
Mix good and bad news? Competitive disadvantage? Internal control? What PSI is outside company control?
3.
RELEASE?
HOW?
WHEN?
Adviser help with PSI timing judgments. Do non-PSI timing in company.
feedback
PSI Learning
4a. NON-PSI
Non-PSI to network.
Use analysts and fund managers to influence market.
Company insiders can continue to trade once this new information is clearly recognised as non-PSI, eg., directors, managers, core FIS and analysts.
4b. PSI
Voluntary PSI release to market.
Observe information release and market price/volume change.
Insiders cannot trade on this information. Place embargo on internal and external insiders on trading until becomes public.
Feedback

than implied by the form of the regulatory framework. Both in this case, and most of the others, considerable effort was expended to cope with uncertain interpretations (an effect that could have been exacerbated by the force of the Stock Exchange guidance which clearly puts the onus on the companies—rather than market participants—to regulate and control information flows). The guidance, although helpful to managers in some respects, was interpreted as another layer of complexity, in which responsibility and risk were clearly located in the company. The data indicate that the participants faced the following problems with the regulatory concepts of information that were discussed in Section 4 of this paper.

- The conceptual boundaries change with new legislation and case law.
- The concepts of information may appear clear in legal terms, but prove very difficult for companies to put into operation.
- The conceptual boundaries are much more ambiguous in practice than they appear in the law.
- Corporate judgments about what information is likely to be 'price-sensitive' and to what extent the price will change are often problematic.
- Assessing the risks of a Stock Exchange and DTI investigation are difficult.
- The requirement that companies be aware of the market expectations built into the company's share price is a more significant problem than indicated by the regulations.

It was notable that the question: '*What information is not PSI?*', was in many ways more important to the research participants than the question: '*What is PSI?*'. The emphasis on non-PSI was a sharp contrast with the Stock Exchange committee's focus on PSI. It is possible that the different emphasis is due to the considerable ambiguity in the assessment of the price-sensitive potential of information coupled with asymmetrical risks and costs. Regulators wish to appear to be preventing the misuse of PSI, but companies want to foster an active investor community by providing them with information while protecting themselves from the possible adverse consequences of PSI misuse.

The interview data highlighted the positive aspects of 'network' communication, whereas the Stock Exchange committee stressed the social control, regulatory and negative aspects. From the company perspective, the effective management of City communication was the central issue, with the problem of PSI dissemination acting as a necessary constraint on interactions perceived as legitimate. In contrast, the Stock Exchange guidance focused on maximising flows direct to the public domain and in setting up constraints on the use of the network.

Thus the case companies saw their PSI decision problem as part of a larger corporate communications decision policy, which was driven by strategy and corporate financing policy and not by regulation and the ideals of fair markets encapsulated within them. Participants' broader aims included:

- Maximising flows of information *from* analysts, financial institutions and the press; about themselves, competitors, the industry and the economy.
- Maximising corporate understanding of all possible PSI and non-PSI sources.
- Understanding the internal and external events creating corporate-derived PSI.

They also perceived a broader set of constraints on their communication policy other than the legal and Stock Exchange guidance constraints, including:

- The competitive disadvantages of releasing sensitive information placed an upper limit on certain information releases.
- The perceived limitations of financial reporting meant that all the case companies felt a need to release more than statutory and listing requirement minima.

Thus the corporate definition of the PSI problem was much broader than that of the Stock Exchange guidance or of the law; it was dynamic in character, and involved many grey areas.

The difficulties the case participants faced in defining and managing PSI illustrates the limits of formal regulation in establishing clear-cut boundaries for corporate behaviour in the PSI area. There is very little empirical evidence on how formal regulatory systems might work in controlling inadvertent PSI release and insider dealing. US case law in the 1980s sought to define illegal insider trading. Seyhun (1992) reports that insiders were less likely to trade where case law had previously identified trading before specific events (takeovers, earnings announcements etc.) as illegal and that insiders were more likely to look for events and privileged information not covered by case law before they traded. Seyhun also observed that increased statutory sanctions in the 1980s did not produce an additional deterrent on the profitability or volume of insider dealings and indeed that top executives, as insiders, seemed to have traded more often on more valuable information in the 1980s. Finally, Seyhun reports that shareholders do not seem to have pressurised management to establish codes of conduct to restrict insider dealing by management.

If the US evidence applies to the UK, then perhaps UK insiders considering trading, corporate staff dealing with the release of inside PSI, and financial institutions receiving information directly and privately from companies, have less to fear than the current debate implies. The apparent limitations of statute and case law (and voluntary shareholder pressure) in the US illustrate how difficult it is to regulate in this field to deter deviant behaviour and to provide management with clear-cut behavioural boundaries. The growth and profitability of publicly observable insider trades by top US executives, based on material or price-sensitive information, cannot be effectively controlled by the growing combination of legal controls. The facts quoted in the *Sunday Times*—'In the decade after insider dealing was made illegal in 1980, the Stock Exchange referred 180 cases to prosecuting authorities but only 26 resulted in legal action, and just 10 convictions were secured,' (21 August 1994, news p.3—Scottish edition) indicate similar 'enforcement' problems in the UK to those evidenced in the US.

The apparent difficulties of legal measures in both the UK and US may lend support to the UK notion of trying to exercise control at the level of the firm and its links with financial institutions, analysts and the media. At the minimum this approach has little to lose. Despite its own limitations, it may compensate for the limitations of the other regulatory mechanisms, and the combination of this form of self-regulation and law may be more effective than one mechanism alone. It builds on existing corporate City communication processes and thus can be implemented at lower cost than a wholly new approach. Finally, it can be a source of 'good practice', which in turn may be more effective in delineating acceptable and deviant corporate behaviour.

8.2. The voluntary disclosure literature

The interpretations in this research bear strong similarities to work by Gibbins et al. (1990) on corporate management of voluntary disclosures. Gibbins et al. investigated disclosure processes in 20 Canadian firms and employed a similar grounded theory approach to developing a structure for disclosure. The context for Gibbins et al. is quite different, but similar concepts and structures have arisen in both pieces of work.

Gibbins explains the interaction amongst the model components as follows:

> 'The disclosure process involves producing disclosure outputs in response to internal or external stimuli...'
>
> 'The firm's readiness to disclose is a function of its developed disclosure position, the existence of internal or external structures for handling disclosures, and the presence of... external mediators. Disclosure position has a number of significant internal and external antecedents. Antecedents may also effect structure and the use of external mediators, as may disclosure position itself.'
>
> 'When management perceive an issue having disclosure implications, any disclosure norms and opportunities are (or may be) identified. Disclosure position, mediators and structure may influence the identification of issues and the perception of associated norms and opportunities. Then disclosure outputs are generated as a function of the perceived norms and opportunities, the disclosure positions's ritualistic and opportunistic dimensions, and any existing structures' (Gibbins et al., 1990, p. 128).

Comparing our data and interpretations to this model we are able to:

- Reinterpret our data and derived structures within a broader framework, providing an alternative view of the structures and interrelationships identified in this study; and
- Build on previous work, analysing the differences and similarities between the studies.

This leads us to the development of a more dynamic model than that presented by Gibbins et al. and moves towards more, problematically, generalisable results.

Both studies identify the use of corporate communications processes. These produce wide varieties of disclosure outputs in response to internal or external event stimuli, together with model elements that indicate the importance of disclosure policy (termed predisposition or disclosure position in Gibbins et al.) and internal and external (boundary) response structures on corporate disclosure outputs.

The research results begin to differ when we look at specific structures. In this research, predisposition and structure were themselves functions of various antecedent conditions such as insider dealing law, Stock Exchange guidance, corporate strategy, financial policy and corporate defences against takeover; the first two factors acting as external constraints on corporate behaviour. The last three of these internal antecedents appear to determine the aims of City communications and shape the message to be communicated to the City. In Gibbins et al., predisposition and structure were functions of various internal antecedent conditions such as corporate history, corporate strategy and internal politics. We did not find evidence of the effect of corporate history and internal policies, but did confirm the importance of corporate strategy.

Gibbins et al.'s external antecedent conditions included legislation, the existence of inter-organisational networks, and industry norms for disclosure. With the exception of industry norms, all of these were confirmed by our case data. We found commonality across industries, possibly indicating the important influence of broader professional norms or the overriding importance of common

City communication problems. Possible reasons for this difference may be that (a) we did not specifically investigate disclosure to non-City participants, and (b) the closeness of our participants to the financial markets may have dominated industry-specific influences.

Our results indicate that the case companies' readiness to disclose was a function of their developed City communication policy, the existence of a structured PSI decision process and of responsive internal or external structures for handling disclosure, the presence of internal advisers and communication specialists, and the ready availability of external mediators or legal and communication specialists. Disclosure position had a number of significant internal and external antecedents. Further, we found that changes in the antecedents, especially in the Stock Exchange guidance, effected internal and external structures and the use of external mediators. These changes intensified efforts to rationalise and clean up internal and external structures, including the mode of external mediators' involvement, thus showing the dynamic nature of the interaction here. Antecedents change, and with them structures, norms and disclosure readiness. For example, one change observed was the closing down of some analyst links, to be replaced by more intensive institutional links.

When management perceived an event having PSI or general City communication implications, PSI mandatory releases or City communication opportunities were identified. The identification of events and issues and the classification of these as PSI or non-PSI were found to be influenced by disclosure responsiveness or readiness, external mediators, extant communication, information systems and relationship structures, and perceived market and professional norms. Generally, we found that PSI was released once a 'script' was ready and when the timing was deemed appropriate. The communication of non-PSI was found to be a function of the company's perceived strategic aims and finance policy, and communication norms established in the marketplace. Opportunism as a factor in disclosure position was identified, inter alia, in the tendency for executives to seek opportunities for the timing of information releases/disclosure outputs and for matching with other news.

Gibbins et al. identified passive ritualistic behavioural influences as an element of disclosure position, defined as '...a propensity towards uncritical adherence to prescribed norms' (p. 130). There is evidence in this study that the recent antecedent (regulatory) changes had disrupted previous forms of ritualism, such as the brokers' analysts lunch. Further, there were indications of the development of structured decision processes, which in time may become new forms of ritualistic behaviour, possibly via the structuring of response systems and classification of PSI and non-PSI events types.

There are strong similarities in terms of the overall structures identified, and the components of voluntary disclosure and communications models, in both pieces of research. In addition, both place similar emphasis on opportunism, policies, structures and processes. Furthermore, both studies demonstrate potential causal links between these components. The differences between the studies may be attributed to:

- The very different decision context for the study participants and differences in the foci of the studies. Our study has a different focus, on the joint problems of PSI indentification and City communications—rather than on voluntary disclosure issues—and was not restricted to purely financial disclosures.
- This study looked at large UK companies, many with their HQs located in or near the City of London, and all of the companies in our sample experienced the strong influence of the concentrated capital of sophisticated City institutions. Gibbins et al.'s sample was more widely disbursed and made up of smaller companies.
- The recent regulatory changes were a strong and central influence on this study and were reflected in an equivalent corporate change process in the cases. This change in antecedents led to changes in corporate internal and external structures, to corporate state of disclosure readiness, in the use of mediators, and the interaction with perceived and defined norms and opportunities.
- The emphasis here was on events rather than issues.

The Gibbins et al. model is very useful for interpreting these case data. However, this research indicates that their framework is possibly an oversimplification; not allowing for adequate change and dynamic interaction between the components and failing to indicate some of the reciprocity of the relationships.

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Appendix

The case companies

Case No.	*FT sector*	*Capital >£b **	*Length of interview hours*	*Month/year*	*Interviewee position*
1	Support services	>0.5	1½	8/93	Group finance director and IR manager
2	Textiles and apparel	>0.5	1½	8/93	Group finance director
3	Paper/package	>0.5	1½	8/93	Chairman and chief executive
4	Paper/package	>0.5	2	8/93	Chief executive
5	Insurance	>1	1½	9/93	Senior financial accountant
6	Oil integrated	>10	2½	10/93	IR director
7	Breweries	>1	1½	10/93	Finance director
8	Banks retail	>10	2	11/93	Investor relations manager
9	Tobacco	>10	2	11/93	Investor relations manager
10	Food producers	>1	1½	11/93	Chief executive and chairman
11	Chemicals	>5	2	11/93	Group IR manager and assistant IR manager
12	Paper/package	>0.5	2	11/93	Chief executive
13	Food producers	>1	2	12/93	Finance director
14	Engineering	>1	2½	1/94	Finance director and public affairs executive
15	Breweries	>1	2	3/94	Director of corporate affairs and IR director
16	Telecoms	>20	2	3/94	Investor relations manager
17	Retailers food	>1	1½	3/94	Investor relations director
18	Retailers	>0.5	2	3/94	Corporate affairs adviser
19	Oil integrated	>20	2	3/94	Director of investor relations
20	Electronic and equipment	>10	1½	3/94	Finance director
21	Banks retail	>1	2	4/94	General manager and secretary
22	Chemicals	>1	1½	3/94	Head of corporate communications
23	Engineering	>1	2	3/94	Controller of investor relations
24	Food producers	>5	2	3/94	Head of investor relations
25	Media	>5	2	3/94	Manager of corporate relations
26	Property	>1	2	3/94	Finance director
27	Pharmaceuticals	>20	1½	3/94	Board director company communications and IR director

* Size capitalised value of the company in October 1993 (by bands).
The cases and quotes included in the text have been edited to preserve the confidentiality of the sources.

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Auditor Market Share, Product Differentiation and Audit Fees

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Abstract—This study examines the effects of auditor market share and product differentiation on audit fees. Previous studies have attributed the price premium charged by the Big Eight (the Big Six in the present study) to Big Eight product differentiation. However, such a price premium could be partly due to monopoly pricing. In the present study, the Hong Kong audit market provides a unique setting in which a non-Big Six local auditor has a market share comparable to those of the third and fourth largest Big Six firms. This makes it feasible to control for the effects of market share via matching. Also, the wide disparity among the Big Six firms' market shares in Hong Kong makes it feasible to test for the effects of market power on audit fees. The results show that, consistent with prior studies, the Big Six audit firms charge higher audit fees than non-Big Six firms in the small auditee, but not the big auditee, market. This suggests that similar economic forces to those other audit markets are also at work in Hong Kong. Despite the Big Six firms' widely different market shares, there was no price differentiation among them. Yet there was a Big Six price premium over the large local firm with a similar market share to those of two of the Big Six. Together, these results suggest that the Big Six price premium is a result of product differentiation rather than monopoly pricing.

1. Introduction

As a result of their dominance in the audit services market, the Big Eight (the Big Six in the present study)[1] have been accused of monopolising the audit market and charging higher than competitive fees (US Senate, 1977). A number of studies have explored the validity of this allegation by examining the effect of audit firm size on audit fees in the US (Francis and Simon, 1987; Palmrose, 1986; Simunic, 1980), Australia (Francis, 1984; Francis and Stokes, 1986), the UK (Chan, Ezzamel and Gwilliam, 1993; Pong and Whittington, 1994; Taffler and Ramalinggam 1982), New Zealand (Firth 1985) and Canada (Anderson and Zeghal, 1994; Chung and Lindsay, 1988).

These studies have commonly assumed that price competition prevails in the small auditee market segment because of the lower supplier concentration in this segment, but that the large auditee market segment may not be competitive because of Big Eight concentration. By comparing pricing in the two market segments, prior research has drawn inferences on the degree and effects of competition, product differentiation and economies of scale in each segment.

With a few exceptions,[2] the extant findings are generally consistent in that a significant positive relationship was found between auditor size and audit fees for small auditees, but not for large auditees (see Francis and Simon, 1987, pp. 145–148, for a summary of auditor size effects). Given the assumption of competition in the small auditee segment, the higher prices charged by the Big Eight in this segment have been interpreted as an indication of Big Eight product differentiation. In turn, such product differentiation, together with the absence of Big Eight premium pricing in the large auditee segment, has been interpreted as indicating that the market structure for both segments was competitive, and that there were either Big Eight economies of scale, or non-Big Eight diseconomies of scale, in the audits of large auditees.

If the small auditee market segment was not competitive, as assumed[3], then the price premium charged by the Big Eight could be due to monopoly pricing as well as product differentiation. Previous studies have been unable to disentangle the two effects, because, in the markets studied, the Big Eight's market share (a major determinant of market power) was substantially higher than that of non-Big Eight audit firms. In other words, the market power and product differentiation variables were highly positively correlated. The present study attempts to disentangle the effects of these two factors by analysing audit pricing in the unique setting of Hong Kong, where the Big Six firms have widely varying market shares and a non-Big Six local auditor has a comparable market share to two of the Big Six. Differential pricing between the Big Six and the large local firm, but not among the Big Six themselves, can be attributable to characteristics specific to the Big Six other than market share.

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[1] The Big Six audit firms are: Arthur Andersen, Coopers and Lybrand, Deloitte Ross Tohmatsu, Ernst and Young, KPMG Peat Marwick, and Price Waterhouse.

[2] In New Zealand, Firth (1985) found no significant price differences between Big Eight and non-Big Eight audit firms for small auditees. On the other hand, in the UK, Big Eight price premium was found to exist in large auditee markets (Chan, Ezzamel and Gwilliam, 1993; Pong and Whittington, 1994).

[3] A review of the three studies that provide information on concentration ratios for small and large auditee market segments shows that the concentration ratios for 'small' auditee segments, though lower than that of the 'large' auditee segment, are still relatively high. At best, we can only assume that the small auditee market segment is more competitive than the large auditee segment. Chung and Lindsay (1988) reported that Big Eight concentration ratios based on number of audits for 'small' auditees with assets less than C$75m ranged from 0.453

Although DeAngelo (1981) argues that superior audit quality is related to the size of the audit firm, audit services can be differentiated because of differences in auditor reputation (Klein and Leffler, 1981) or other perceived differences in quality. Firth (1990) has shown that public criticism of an auditor has negative effects on the stock price of the auditor's other listed clients. Therefore, an auditor's reputation can have an impact on shareholder wealth and is an important element of audit quality. Thus, in Hong Kong, the two Big Six firm's audit services may be differentiated from the similar sized local firm because of the international reputation acquired by the Big Six firms.

Low, Tan and Koh (1990) and Simon, Teo and Trompeter (1992) showed that audit fee models used in prior studies in the more developed countries also apply in Hong Kong, Singapore and Malaysia. In this study, interviews on audit fee setting were conducted with the partners or principals of audit firms, who also suggested variables similar to those in previous studies.

The results showed that the Big Six audit firms charged higher audit fees than non-Big Six firms in the small auditee but not large auditee market. This finding is consistent with that of previous studies, and suggests that the same market forces apply in the Hong Kong audit market as elsewhere. Despite the Big Six firms' widely different market shares, there was no price differentiation among them. Yet there was a Big Six price premium over the large local firm with a similar market share to those of two of the Big Six. Together, these results suggest that the Big Six price premium is a result of product differentiation rather than monopoly pricing.

The remainder of this paper is organised as follows. The next section provides an overview of the audit market used for empirical testing. Then the research methodology is described, followed by the presentation and discussion of results. A summary concludes the paper.

2. Market setting

The Hong Kong audit market is a highly concentrated market with great diversity of market shares among the Big Six audit firms. Table 1 shows the market shares of audit firms based on audit fees reported by all the publicly-listed companies. Table 2 shows that the audit market for the 'small' auditee segment was less concentrated than the market for the 'large' auditee segment.

The Hong Kong audit market is used for empirical testing because it has two advantageous features for the purposes of this study. First, a large local firm (Kwan Wong Tan & Fong[4]) exists, with a market share comparable to those of the third and fourth largest Big Six firms (Table 1). The existence of this local firm makes it feasible to control (via matching) for the effects of market share, which has been suggested as a key determinant of market power (Gale and Branch, 1982; Ravenscraft, 1983; Shepherd, 1972, 1990). Second, there is a wide disparity among the Big Six firms' market shares, both in the overall market and within the 'large' and 'small' auditee segments (Table 2). This latter feature makes it feasible to test for the effects of market power, since the Big Six firms can be assumed to offer a relatively homogeneous product.

3. Research methodology

3.1 *The sample*

The sample consisted of all companies listed on the Hong Kong Stock Exchange as of 31 December 1990. Only listed companies were studied, because unlisted companies' annual reports are not publicly available. Seven banks were excluded because Simunic (1980) has shown that banks are outliers with very low fees, which was also true for banks in this study.

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to 0.842 in 1979. In Simunic's study (1980), Big Eight concentration ratios based on number of audits for 'small' auditees with assets less than US$100m were reported as ranging from 0.59 to 0.82. A recent study by Tonge and Wootton (1991) shows that Big Six concentration ratios based on client's revenues for auditees with revenues less than US$100m range from 0.749 to 0.892. The concentration ratio ranges for 'large' auditees in these three studies are respectively: 0.905 to 0.956; 0.88 to 0.95; and 0.907 to 0.987. It should be noted that concentration ratios based on the number of audits are much lower than those based on audit fees or other client variables (Lee, 1994). Therefore, concentration ratios reported in Chung and Lindsay's study and Simunic's study are comparatively understated.

[4] Although Kwan Wong Tan & Fong is a member of an international overseas firm, Binder Dijker Otte, it is of Hong Kong origin, and is regarded by clients as a local firm.

Table 1
Market shares and rankings of public accounting firms by audit fees from all publicly-listed companies in Hong Kong (1990)

Audit firm	*Audit fee % (ranks in parentheses)*	
The Big Six firms		
Price Waterhouse	37.8	(1)
KPMG Peat Marwick	28.5	(2)
Ernst & Young*	9.4	(3)
Deloitte Ross Tohmatsu*	8.6	(4)
Coopers & Lybrand	1.1	(7)
Arthur Andersen	0.8	
Others		
Kwan Wong Tan & Fong	8.4	(5)
H.C. Watt	1.5	(6)
Thomas Le C. Kuen	1.0	(8)
M.B. Lee	0.1	
Others	2.8	
	100.0	

*In Hong Kong, Ernst & Whinney merged with Arthur Young to form Ernst & Young on 1 January 1990, and Deloitte Haskins & Sells merged with Touche Ross to form Deloitte Ross Tohmatsu on 1 April 1990.

Twelve companies with joint auditors, 15 foreign companies[5], 21 companies with initial audits,[6] and 21 companies with missing information were also excluded. The final sample consisted of 224 companies.

The median and mean assets (in millions) for the total sample are HK$730m and HK$3,350m respectively (US$1 = HK$7.8 approximately). Companies were classified as large and small, based on an asset value of HK$1,000m, as this size cut-off is reasonably close to those used in previous studies in other countries; e.g. Anderson and Zeghal (1994) split the sample at total assets of C$100m (in constant 1980 dollars) and Palmrose (1986) used asset value of US$150m as the size cut-off.

3.2. The Model

Since audit fees in Hong Kong may be dependent on factors other than those used in other countries, unstructured interviews were conducted with the Hong Kong audit partners or principals of four Big Six firms and several non-Big Six firms. Each interview lasted for about one hour for Big Six firms, and ranged from 15 to 30 minutes for non-Big Six firms. During the interviews, interviewees of the Big Six firms emphasised that they charge higher fees because of the high quality of their services. Partners from the Big Six and non-Big Six firms also suggested that competition existed among the Big Six firms. All the interviewees named auditee size, audit risk and audit complexity as the major factors in setting audit fees. Other factors, such as the year-end month and strength of clients' internal audit systems, were also mentioned by some of the audit partners. Thus, the set of variables in the interviews are similar to those used in previous studies in other countries. Table 3 summarises those variables that had been found to be significant in at least one previous study. This set of variables includes auditee assets, subsidiaries, number of industries, foreign assets or foreign subsidiaries, current asset components, equity ratio, and qualified audit opinions.

Although strength of client's internal audit systems is perceived by auditors to have an impact on audit fees, data on internal auditing expenditures are not available, and are not included in the model. The findings on the effect of internal audit costs on audit fees have been mixed. While An-

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[5] Foreign companies were excluded for three reasons: (1) their financial results are usually reported under the regulations of the country where their main business is located and, therefore, auditor's remuneration is usually not reported; (2) the setting of audit fees is likely to be determined by the auditors of the overseas parent companies; and (3) their operating results reported in the financial reports include the worldwide operation of which the operation in Hong Kong usually only forms a minor part. However, those companies that have changed their domiciles to other countries, but retain their major business in Hong Kong and are regarded as domestic companies by the Hong Kong Stock Exchange, were included in this study.

[6] Initial audits were excluded because DeAngelo (1981) had shown that audit firms tend to cut their price on initial audit engagements. When companies with initial audits were included in the model, the initial audit indicator variable was negative but insignificant (p = 0.5295), and the regression results were basically the same as those presented in Table 5.

Table 2
Auditor market shares (by audit fees and auditees' total assets) of small and large publicly-listed companies in Hong Kong–(1990) (ranks in parentheses)

	Audit firm %				*Auditees' total asset %*			
Audit firm	*Auditees with assets greater than HK$1,000m*		*Auditees with assets less than HK$1,000m*		*Auditees with assets greater than HK$1,000m*		*Auditees with assets less than HK$1,000m*	
Price Waterhouse	42.3	(1)	17.1	(2)	41.0	(1)	19.1	(2)
Peat Marwick	31.8	(2)	13.7	(5)	43.1	(2)	12.3	(5)
Ernst & Young	8.1	(3)	15.5	(3)	3.1	(4)	12.4	(4)
Kwan Wong Tan & Fong	7.0	(4)	14.5	(4)	7.9	(3)	17.3	(3)
Deloitte Ross Tohmatsu	4.8	(5)	25.9	(1)	1.9	(5)	22.7	(1)
Arthur Andersen	0.9	(6)	–		0.7	(6)	–	
Coopers & Lybrand	0.5		4.1	(6)	0.1	(7)	5.0	(6)
Others	4.6	(7)	9.2		2.2		11.2	
	100.0		100.0		100.0		100.0	
Big Six market share	88.4%		76.3%		89.9%		71.5%	

derson and Zeghal (1994) found that internal audit costs had a significant positive effect on audit fees in the large auditee segment, Chung and Lindsay (1988) and Simunic (1980) found no significant relationship between internal and external audit costs.[7] O'Keefe, Simunic and Stein (1994) also showed that the degree of reliance on internal control had no statistically significant effects on audit hours or the audit fee. These previous findings suggest that omission of the internal control variable from the model is not likely to have a significant impact on the results.

The final fee model is summarised by the following equation:[8]

$$\text{LNFEE} = b_o + b_1\text{LNASSET} + b_2\text{SUBS} + b_3\text{FOREIGN} + b_4\text{INDUSTRY} + b_5\text{CA} + b_6\text{EQUITY} + b_7\text{OPINION} + b_8\text{CONS} + b_9\text{IND} + b_{10}\text{BIG6} + b_{11}\text{KWAN} + e_i$$

where:

LNFEE = natural logarithm of audit fees;

LNASSET = natural logarithm of total tangible assets;

SUBS = total number of consolidated subsidiaries;[9]

FOREIGN = the proportion of foreign subsidiaries to total subsidiaries;

INDUSTRY = the number of industries in which the company operates;

CA = the ratio of current assets to total assets;[10]

EQUITY = the ratio of long-term liabilities to total assets;

OPINION = a dummy variable having a value of 1 if the auditee had received a qualified opinion,[11] zero otherwise;

CONS = a dummy variable having a value of 1 if the industry of the auditee is a consolidated industry,[12] zero otherwise;

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[7] Chung and Lindsay (1988) and Simunic (1980) tried to include internal audit cost as a dependent variable; however, the results were unsatisfactory, which suggested incorrect model specification for internal audit cost and/or errors in the measurement of this variable.

[8] Several other variables, such as the ratio of net income to total assets, dummy variables representing the two popular year-ends in Hong Kong, March and December, and a dummy variable indicating whether loss had been incurred for at least two of the three preceding years, were included and tested. They were not included in the final model because of the lack of consistent empirical support in previous research and their statistical insignificance in this study.

[9] In Hong Kong, it is quite common to have dormant subsidiaries. As these subsidiaries will not affect the complexity of the auditor's work, they were excluded from the number of subsidiaries.

[10] Different measures of current asset composition ratios (account receivables to total assets, inventories to total assets, account receivables and inventories to total assets and quick asset ratios) were tested, and the best fit was provided by the current asset ratio.

[11] Qualified opinions include the 'except for', 'subject to', 'disclaimer' and 'adverse' opinions. The 'subject to' opinion (which has been removed since 1994) was issued when the uncertainty was material, but not fundamental. A 'disclaimer' would be issued if the uncertainty was both material and fundamental. The 'except for' was issued when the disagreement between the auditor and management was material. An 'adverse' opinion was issued when the disagreement was material and fundamental.

[12] Industries are classified by the Hong Kong Stock Exchange as consolidated, industrial, property, finance, hotel,

Table 3
Variables in Prior Main Studies

	US				Australia		New Zealand		UK		Canada	
	Simunic (1980)	*Simon (1985)*	*Palmrose (1986)*	*Francis & Simon (1987)*	*Francis (1984)*	*Francis & Stokes* (1986)*	*Firth (1985)*		*Chan Ezzamel & Gwilliam (1993)*	*Pong & Whittington (1994)*	*Chung & Lindsay (1988)*	*Anderson & Zeghal* (1994)*
Dependent variable	$\frac{Fee}{Assets^{0.5}}$	$\frac{Fee}{Assets^{0.5}}$	*Ln(Fee)*	*Ln(Fee)*	*Log(Fee)*	*Log(Fee)*	*Fee*		*Log(Fee)*	*Fee*	$\frac{Fee}{Assets^{0.5}}$	*Ln(Fee)*
							1981	*1983*				
Explanatory variables:												
Auditee assets			+	+	+	+	+	+	+T.O.	+		+
Subsidiaries	+	+	b	+	+	+	a	a	+	+	+	+
Industries or diversification	+	a	b	b	b	b	b	b	+	b	a	a
Foreign assets or subsidiaries	+	+	b	+	b	b	b	b	b	b	+	+large
Receivable %	+	a	b	+	+	+	+	+	b	b	+	+
Inventory %	+	+	b	+	+	+	a	a	b	b	+	+
Profitability	a	b	b	b	a	+large	a	a	−	−	a	a
Loss in recent years	+	b	b	b	a	a	a	a	b	b	a	a
Qualified audit opinions	+	a	+	+	a	+small	b	b	b	b	b	b
Equity - debt	b	b	b	b	a	−small	b	b	b	b	b	b
Auditor size	−	a	+	+	+	+small	a	a	+	+	a	+small
Unsystematic risk	b	b	b	b	b	b	+	+	b	b	b	b
Public/non-public	b	b	+	b	b	b	b	b	b	b	b	b
Ownership	b	b	b	b	b	b	b	b	−	b	b	b
Locations	b	b	+	b	b	b	b	b	+	b	b	b
Audit delay	b	b	b	b	b	b	b	b	+	b	b	b
No. of reports	b	b	+	b	b	b	b	b	b	b	b	b
Client participation	b	b	−	b	b	b	b	b	b	b	b	b
Current cost accounts	b	b	b	b	b	b	b	+	b	b	b	b
Internal audit cost	a	b	b	b	b	b	b	b	b	b	b	+large

* Only regression results for the samples of small and large auditees were reported in these studies.
** A different specification of audit fee model was used in this study.
+ The variable was found to be positively significant.
− The variable was found to be negatively significant.
a The variable was included and tested in the model but was found to be insignificant.
b The variable was not included in the regression model.
large Large auditees.
small Small auditees.
T.O. Turnover.
NB Only those variables that were found to be significant in at least one study are presented.

IND = a dummy variable having a value of 1 if the auditee's industry is industrial, zero otherwise;
BIG6 = a dummy variable having a value of 1 if the auditor is one of the Big Six, zero otherwise;
KWAN = a dummy variable having a value of 1 if the auditor is Kwan Wong Tan & Fong, zero otherwise; and
e_i = an error term.

Companies in Hong Kong are required to report remuneration to auditors.[13] The information for the dependent and independent variables were hand-collected from the sample firms' 1990 published annual reports.

Table 4 presents descriptive statistics for the dependent and independent variables. The mean assets (in millions) for the small auditee and the large auditee segments are HK$423.7m and HK$7,044.1m respectively. These are within the range of mean assets of previous studies, which showed distinctive pricing effects in the large and small auditee segments (see Francis and Simon, 1987, pp. 145–148, for a discussion of mean asset size across studies). About 71% of the sample companies were audited by the Big Six. This is again within the range reported in previous studies; e.g. 62%, 69%, 83% and 93% were reported by Francis and Simon (1987), Pong and Whittington (1994), Palmrose (1986) and Anderson and Zeghal (1994) respectively.

4. Results and discussion

Table 5 reports ordinary least squares (OLS) regression results for the total sample and the two auditee size segments. All three models are statistically significant, with adjusted R-squares ranging from 0.4585 to 0.7012. Tests indicated that the regressions were well specified.[14,15]

In the results for the total sample, the coefficients for all the control variables except OPINION have signs consistent with those from previous research studies. LNASSET, SUBS, INDUSTRY and CA are significant at the 0.05 level. Consistent with previous studies, LNASSET is the most significant independent variable. It alone accounts for 51% of the variation in audit fees. The insignificance of OPINION may be due to the small number of qualified opinions received by auditees.

The BIG6 variable is positive and significant at the 0.001 level. To determine that the BIG6 coefficient is not driven by one or two firms with the largest market share, the regression was also run with a separate indicator variable for each Big Six audit firm instead of the single BIG6 variable. All six of these variables are positive and five are significant at 0.1 level. This indicates that Big Six audit firms were charging higher fees than the non-Big Six firms. However, the coefficient for KWAN is not significant. Since the market share of Kwan Wong Tan & Fong (Kwan) is comparable to those of the third and fourth ranked Big Six firms, this finding is suggestive of Big Six product differentiation.

The OLS regression results for the large and small auditee segments (Table 5) also show that there is a Big Six price premium in the small, but not the large, auditee segment.[16,17] This result is

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utility and others. The definitions of each industry category are not publicly available. An examination of the annual company reports indicates that consolidated companies are mainly those with several main areas of operation, while industrial companies are mainly manufacturers. Indicator variables representing consolidated and industrial industries were only included in the model because indicator variables for the other industries were not significant.

[13] The Hong Kong Society of Accountants defines auditors' remuneration as the payments for audit services.

[14] An examination of the residual and the normal probability plots indicated that the regression assumptions of linearity and normality were not violated. The Studentized residual and Cooks-D-Statistics identified two possible outliers. Rerunning the model by excluding these two observations yielded results similar to those reported in Table 5. Hence, the results based on the full sample are presented here. Heteroscedasticity in the model was tested using the Goldfeld-Quandt test. The calculated F-ratio was 0.552, which was not significant at the 0.05 level. The absence of heteroscedasticity was further confirmed by White's test. Variance inflation factors (VIF) for all explanatory variables are below 2.0 except for the BIG6 and KWAN variables, with values of 2.5. Since all the VIFs are less than the problem indication level of 10 (Neter, Wasserman and Kutner, 1989), multicollinearity is not a serious problem in this study. Similar results apply to the large and small auditee segment regressions.

[15] Following previous research, different specifications of the model also were estimated. For example, fees deflated by square root of assets was used as the dependent variable by Simunic (1980) and Chung and Lindsay (1988); fee was regressed against square root of asset and other control variables in Firth's study (1985). The results were not qualitatively different from those reported in Table 5. As a note of interest, a simple regression of ln(Fee) against ln(Assets) was found to yield an intercept of 3.13 and a slope of 0.47. These were very close to the findings in Simunic's study (1980), which reported an intercept of 3.33 and a slope of 0.45.

[16] When the BIG6 variable was replaced by six auditor dummy variables representing each of the Big Six firms, all of the five Big Six indicator variables in the small auditee segment (Arthur Andersen did not have clients in this segment) were positive and significant. On the other hand, none of the auditor variables were significant in the large auditee segment.

[17] The finding that no Big Six premium existed in the large auditee segment is in contrast to the results of a previous study of audit fees in Hong Kong, which found a Big Six price premium for a random sample of 99 large companies that were comparable in mean assets to the large auditees in this study. Since that study did not report how the sample was selected, it would be difficult to compare their results with this study. The fact that Simon, Teo and Trompeter (1992) collected data from a different time period (1987 and 1988), and that only client assets, inventory and receivables proportion and number of subsidiaries were used as control variables in the model, may account for the different results.

consistent with previous research, which has interpreted it as indicating that there were either Big Six economies of scale, or non-Big Six diseconomies of scale, in the audits of large auditees. The lower predictive power of the model for small auditees is also consistent with the findings of previous research (e.g Chan, Ezzamel and Gwilliam, 1993; Chung and Lindsay, 1988; Francis and Stokes, 1986; Palmrose, 1986; and Simunic, 1980). In the separate regressions for each size segment, a number of variables become insignificant. In particular, the t-values for FOREIGN and INDUSTRY in the small auditee segment have dropped below one. This may be explained by the fact that small auditees are usually less diversified in industries, and that their foreign subsidiaries are usually located in neighbouring countries.

The unique setting of the Hong Kong audit market made it possible to run two additional OLS regressions to further investigate the product differentiation hypothesis. First, the audit fee model was estimated using only the auditees of Kwan Wong Tan & Fong and the two Big Six firms with comparable market shares. Deloitte Ross Tohmatsu and Ernst & Young. A dummy variable, DREY, was included, which was coded one for the two Big Six firms, and zero otherwise. The model was significant at the 0.0001 level (F=20.89, adjusted R-square=0.63) as shown in Table 6. Despite their comparable market shares, the fee charged by the two Big Six firms was significantly higher than that by Kwan Wong Tan & Fong (t=2.048, p=0.043). Given the matching on market share, this finding is consistent with Big Six product differentiation.

Second, the audit fee model was estimated using only the Big Six auditees. A dummy variable, BIG, was included, which was coded one for the two Big Six firms with substantially higher market shares than the others, Price Waterhouse and KPMG Peat Marwick, and zero otherwise. The model was highly significant (F=37.69, p=0.0001, adjusted R-square=0.70) (Table 6), but the coefficient for BIG was not significant (t=1.059, p=0.291).[18] Thus, despite the rather substantial market share differences among the Big Six, there was no price differentiation within this group, yet there was a Big Six price premium over non-Big Six auditors including Kwan. Taken together, these results are more consistent with Big Six product differentiation than monopolistic pricing.

Since people usually associate international names with quality, and the Big Six's wide international network allows them to audit more efficiently, their services are perceived as of higher quality, and therefore auditees are willing to pay a higher price for their services. As Hong Kong is an international city, the presence of a large number of foreign investors creates a strong demand for audit services provided by the international Big Six firms. The product differentiation effect of the Big Six brand name is also supported by Firth (1993), who showed that high audit fees could be charged simply by using a (then) Big Eight firm name, even though the nature and scope of the audit remained unchanged. According to some of the Big Six partners, underwriters and bankers in Hong Kong often recommend the use of Big Six audit firms when companies go public. This is further evidence that the capital market places higher value on audit services provided by the Big Six.

Table 4
Descriptive Statistics

	Total sample (n=224		*Auditees with assets less than HK$1,000m (n=125)*		*Auditees with assets greater than HK$1,000m (n=99)*	
Variable	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
FEE ($000)	981.40	1322.60	463.50	300.40	1635.50	1758.30
ASSETS ($m)	3349.70	7430.50	423.70	255.40	7044.10	10042.20
SUBS	21.10	22.00	11.30	7.60	33.40	27.40
FOREIGN	0.19	0.23	0.20	0.24	0.18	0.21
INDUSTRY	2.30	1.00	2.00	0.80	2.70	1.20
CA	0.40	0.27	0.47	0.28	0.32	0.24
EQUITY	0.11	0.33	0.10	0.41	0.13	0.18

Percentage of companies receiving a qualified opinion	2.0%
Percentage of companies audited by Big Six	71.5%

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[18] Regressions were run six more times on the sample of Big Six firms, each time with one dummy variable representing one of the Big Six firms. Again, none of the Big Six variables was significant.

Table 5
Regression Results: Dependent Variable is Ln Audit Fee

	Total sample (n=224)		*Auditees with assets less than HK$1,000m (n=125)*		*Auditees with assets greater than HK$1,000m (n=99)*	
Variable	*Coeff*	*t-statistic*	*Coeff*	*t-statistic*	*Coeff*	*t-statistic*
INTERCEPT	2.270	9.258***	2.533	5.323***	2.507	5.317***
LNASSETS	0.404	13.011***	0.348	4.743***	0.387	7.505***
SUBS	0.010	4.473***	0.025	2.974***	0.009	4.516***
FOREIGN	0.264	1.615*	0.030	0.130	0.434	1.809*
INDUSTRY	0.123	2.984***	0.058	0.773	0.114	2.384**
CA	0.960	6.129***	0.954	4.075***	1.042	4.907***
EQUITY	0.204	1.844*	0.169	1.289	0.284	1.040
OPINION[a]	−0.145	−0.439	−0.106	−0.278	-	-
CONS	0.211	2.236**	0.131	0.865	0.311	2.628***
IND	0.178	1.763*	0.118	0.800	0.215	1.510
BIG6	0.403	3.202***	0.492	2.884***	0.293	1.499
KWAN	0.121	0.826	0.321	1.578	−0.122	−0.555
Adjusted R^2	0.7012		0.4585		0.6355	
F-ratio	48.577		10.543		18.089	
(Significance)	(0.0001)		(0.0001)		(0.0001)	

Significance level (two-tail tests): ***=0.01; **=0.05; *=0.10

Note: [a]None of the large auditee companies received a qualified opinion.

Table 6
Regression Results of the DREY Subsample[a] and the Big Six Subsample[b]

	DREY sample (n=118)		*Big Six sample (n=160)*	
Variable	*Coeff*	*t-statistic*	*Coeff*	*t-statistic*
INTERCEPT	2.422	6.406***	2.454	8.933***
LNASSET	0.405	8.077***	0.411	11.403***
SUBS	0.008	2.198**	0.012	4.373***
FOREIGN	0.508	1.801*	0.046	0.234
INDUSTRY	0.139	2.128**	0.138	2.774***
CA	0.902	3.694***	1.185	6.322***
EQUITY	0.148	1.154	0.222	1.917*
OPINION	−0.282	−0.744	0.279	0.692
CONS	0.158	1.059	0.198	1.714*
IND	0.115	0.791	0.186	1.492
DREY	0.238	2.048**		
BIG			0.101	1.059
Adjusted R^2		0.630		0.698
F-ratio		20.896		37.687
(Significance)		(0.0001)		(0.0001)

Significance level (two-tail tests): ***=0.01; **=0.05; *=0.10

Note: [a]Companies audited by Deloitte Ross Tohmatsu, Ernst and Young, and Kwan Wong Tan & Fong.
[b]Companies audited by the Big Six

4.1. Further Tests

Since the auditor coefficients may have been driven by factors not captured in the model, four further tests were carried out:

1. To test for the effect of size cut-off point, regressions were run using the smallest and largest quartiles (total asset < HK$334m and total assets > HK$2,360m respectively). The auditor variable results remained unchanged.
2. Since Kwan has a relatively large market share in the property industry (26% of the audit fees in the property sector was accounted for by Kwan), the results may have been driven by its specialisation in this industry. Although industry effects have been tested by including industry variables in the model, the effect of industry was further examined by running separate regressions on samples of the total, small and large auditees in the property industry. Similar regressions were run on samples of auditees in other industries. Audit firm pricing differences for the total sample of property group and all the samples of the non-property sectors were similar to that in Table 5. In the property sector where Kwan specialises, KWAN was weakly significantly different from the other non-Big Six firms in the small auditee segment ($p = 0.089$), and became positive in the large auditee segment. However, the KWAN coefficients were still lower than those of the Big Six in both segments. Therefore, despite Kwan's relatively large market share in the property sector, it still could not command a higher price than the Big Six.
3. To test for the possible confounding effect of auditee size on the auditor indicator variable, auditees of non-Big Six auditors were matched with auditees of Big Six auditors with asset size within 10%. This yielded a sample of 106 companies (53 matches) with mean assets of HK$2,931.1m and HK$2,992.1m for companies with Big Six and non-Big Six auditors respectively. Regression results for this subsample (total subsample, small auditee and large auditee segments of the subsample) were consistent with those for the full sample, indicating that auditee size is not a confounding variable.
4. To test whether the same model applies to the small and large auditee groups, a Chow test was performed. The F-ratio of 1.028 was not significant at the 0.05 level. Therefore, the null hypothesis of identical model specification for the two auditee size groups cannot be rejected.

5. Conclusion

Consistent with previous empirical studies in other national settings, a significant positive relationship was found between the Big Six auditor indicator variable and audit fees for the total sample and the small auditee segment, but not for the large auditee segment. This finding suggests that similar economic forces to those other audit markets are also at work in Hong Kong. The finding of a price premium for the Big Six, but not for a large local firm, together with the lack of price differentiation among Big Six firms with widely disparate market shares, suggests that Big Six premium pricing is a result of product differentiation, not the exploitation of market power.

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Measurement of Formal Harmonisation in Accounting: An Exploratory Study

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Abstract—Extant research in evaluation of accounting harmonisation has mainly focused on measurement of harmonisation and evaluation of its impact on share market indicators. Within these themes, however, researchers have been studying the impact of formal harmonisation on material harmonisation, and share prices and returns. Given the important role formal harmonisation plays in accounting harmonisation, this study introduces a methodology for the measurement of formal accounting harmony between countries. The methodology introduced in this paper can be used to identify areas of harmony or disharmony for policy-making purposes. It also provides means of gaining valuable insights into the nature of harmony or disharmony between different countries' accounting rules. Finally, it creates new grounds for examining various other aspects of accounting harmonisation.

1. Introduction

Growing economic cooperation between countries at both global and regional levels has led to greater attention being paid to empirical evaluation of international accounting harmonisation (e.g., see Nobes, 1992). In the accounting literature, the concept of harmonisation has been interpreted in a number of different ways. Tay and Parker (1990) identified two types of harmonisation, namely, de facto harmonisation and de jure harmonisation. The former refers to harmonisation between practices and the latter to harmonisation between regulations. They also differentiated between harmonisation and standardisation, explaining that harmonisation meant clustering of accounting practice around a few available methods with a view to achieving harmony between accounting practices; and standardisation meant strict adherence to one set of rules to achieve uniformity in practices. Van der Tas (1988 and 1992b) provided an alternative terminology for describing harmonisation. He called de jure harmonisation 'formal harmonisation' and de facto harmonisation, irrespective of whether the practices were influenced by regulations or not, 'material harmonisation'.

Extant studies on the evaluation of accounting harmonisation have focused on the investigation of material harmonisation or its effects, rather than researching formal harmonisation. However, practically every study evaluating material harmonisation has measured the effects of the state of formal harmony on practice. For example, Nair and Frank (1981), Evans and Taylor (1982), Doupnik and Taylor (1985) and Yang and Lee (1994) explore the effects of International Accounting Standards Committee standards; Emenyonu and Gray (1992), van der Tas (1992b) and Walton (1992) study the impact of the EU Fourth Directive; and Alford et al. (1993), Amir et al. (1993) and Barth and Clinch (1994) examine the effects of certain countries' accounting standards on share prices, through the standards' effects on accounting numbers. It is, therefore, well recognised that a primary factor driving material harmonisation is formal harmonisation. This view is also evident from the findings of Alford et al. (1993), Amir et al. (1993) and Barth and Clinch (1994), that differences between generally accepted accounting principles of different countries lead to share price and return variations. This, they found, was due to the variations in value relevance of different countries' GAAPs. Consequently, this study proposes to demonstrate the use of a research de-

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sign for evaluating the state of formal harmony across countries.

The remainder of the paper is organised into five sections. Section 2 reviews the literature on accounting harmonisation evaluation and establishes the purposes of this study. Section 3 sets out the research design used for making the necessary comparisons. Section 4 describes the data. The results of the comparisons are analysed in Section 5, with some conclusions reported in the final section.

2. Extant literature

The reviews of international financial accounting research, e.g. Meek and Saudagaran (1990), Wallace and Gernon (1991), Choi and Mueller (1992), Wallace (1992) and Radebaugh and Gray (1993), identify a group of studies that have statistically clustered countries based on accounting and environmental parameters. Within these studies, Wallace and Gernon (1991) explain, accounting practices are compared and contrasted to identify the relative similarity or dissimilarity between different countries. The primary aim of these studies was to broadly categorise the countries or to evaluate the influence of the environmental factors on the general level of disclosure practices or requirements in different countries.

The cluster studies may be seen as a first major step towards examining international accounting harmonisation empirically. Tay and Parker (1990) and Emenyonu and Gray (1992) have identified several studies that empirically measure accounting harmonisation between different countries.[1] Other studies, such as Walton (1992) and van der Tas (1992b), have followed since these reviews.

Measurement studies mainly investigate material harmony at a point in time (e.g., van der Tas, 1988; Walton, 1992; Emenyonu and Gray, 1992) or movements in harmony (e.g., Nair and Frank, 1981; Evans and Taylor, 1982; van der Tas 1992b; and Yang and Lee, 1994). In addition, there have been studies that used other methods for evaluating harmonisation or the need for harmonisation. For example, Adhikari and Tondkar (1992) examined the reasons for the variation between accounting regulations. More recently, a new dimension has been added to research in accounting harmonisation by studying the effects of accounting practice and regulations on share price and return movements. The objective of this type of research is to examine the justification for accounting harmonisation (e.g., Alford et al., 1993; Amir, Trevor and Venuti, 1993; Barth and Clinch, 1994). However, one caveat here is that they do not ascertain whether the accounting numbers are actually being used by investors or how they are being used in share trading decisions.

In short, empirical studies on accounting harmonisation have focused on the state of accounting harmony by measuring the level of material harmony, identifying the reasons for formal harmony and disharmony or examining the impact of the state of harmony on share prices and returns. Therefore, they may be broadly classified as evaluation studies.

From a contextual viewpoint, two groups of studies can be identified in the extant literature on evaluation of harmonisation, i.e., those with a global perspective (e.g., Nair and Frank, 1981; Evans and Taylor, 1982; Alford et al., 1993; Amir et al., 1993 and Barth and Clinch, 1994) and those with a regional perspective (e.g., Doupnik and Taylor, 1985; Walton, 1992; Emenyonu and Gray, 1992; van der Tas, 1992b; Yang and Lee, 1994). The first group uses sample countries (employing Price Waterhouse International indices) or companies from sample countries (using other databases or annual reports) to study the variation in accounting rules and practices between countries at a global level. The second group focuses on evaluating harmonisation within particular clusters of countries.

Accounting harmonisation studies are very much at an experimental stage, where methodology and analytical techniques are still being proposed and tested on particular samples of accounting issues and countries. The accounting issues and countries, in most cases, are to a certain extent purposively selected. For example, global studies of Nair and Frank (1981) and Evans and Taylor (1982) have selected certain basic issues covered by early IASC standards to study the impact of IASC initiatives on global accounting practices. Despite similarities in their purpose, they varied in their results. This is attributable to the differences in the issues selected, countries examined and the analytical techniques used.

Similarly, regional studies have been primarily motivated by regional initiatives to harmonise accounting practice. For example, Walton (1992), Emenyonu and Gray (1992) and van der Tas (1992b), have studied the impact of the EU Fourth Directive on material harmonisation. Some regional studies have, however, investigated the impact of global initiatives. For example, Doupnik and Taylor (1985) and Yang and Lee (1994) studied the movement towards harmonisation by western European and pan Pacific countries, respectively, in response to IASC standards. Again, results of regional studies vary because of variations in the analytical techniques adopted and samples of issues and countries selected.

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[1] Van der Tas (1992a) has argued that not all of the six studies Tay and Parker (1990) reviewed were studies specifically dealing with harmonisation. Tay and Parker (1992) have contended that all six studies were 'more or less' (p. 217) linked with harmonisation.

The market-based studies, such as Alford et al. (1993), Amir, Trevor and Venuti (1993) and Barth and Clinch (1994), have been more purposive in that they examined a particular regulatory measure — the need for Securities and Exchange Commission US GAAP reconciliation requirement for overseas firms listed on US stock exchanges. However, these studies have special experimental features; for example, they look at the effects of only some of the accounting standards or accounting numbers. Moreover, the causal relationship between GAAP and share prices has yet to be clearly established, especially for countries where accounting standards do not necessarily reflect GAAP due to weaker forms of enforcement than that of the US.

Data instruments or sources of data used in harmonisation studies have been mainly of five types: annual reports, accounting regulations, public databases, questionnaires and laboratory techniques. All those using annual reports, public databases, questionnaires and laboratory techniques studied material harmonisation. The only formal harmonisation study, Adhikari and Tondkar (1992), used stock exchanges' listing requirements as the source for accounting regulations. All annual report studies have small samples (between nine to 26 firms from each country surveyed) of mainly large firms. However, in making this observation one should appreciate the difficulties involved in collecting information from annual reports.

The use of public databases, such as Price Waterhouse International indices (PWI 1973, 1975 and 1979), in some of the studies created complications. PWI (1973, 1975 and 1979) seem to mix de jure and de facto aspects in a perplexing way. For example, they rank required and insisted upon methods higher than predominant practice. Required methods and, more specifically, insisted upon methods cannot always ensure greater adherence to a practice; especially if prescriptions are issued without government backing, they may at times be minority practice. The adoption of current cost accounting and investment property accounting standards in New Zealand highlighted this issue. In the case of current cost accounting, the standard had to be reduced to the status of a recommendation in 1986 due to non-compliance and, for investment property accounting, the standard had to be changed in 1989 to accommodate the predominant practices. Accounting standards in New Zealand had no government backing until July 1994. Therefore, they did not attract 100% compliance, as is assumed by PWI indices. A similar situation prevailed in most countries at the time of the PWI surveys. Consequently, the PWI indices' mixing of regulations with practices to reflect prevailing practices is misleading. In addition to this, Nobes (1981) identified several other problems associated with PWI indices.

For their study of formal harmonisation, Adhikari and Tondkar (1992) surveyed the reporting requirements of 35 stock exchanges from different countries. Although this is commendable, their study did not include other more influential sources of regulation, i.e., statutory requirements and accounting standards. In countries such as the UK, US, Australia and New Zealand, both company law and accounting standards are more prescriptive than stock exchange requirements in financial reporting. They not only influence the stock exchange requirements for financial disclosure, but also directly influence the listed firms on many issues not included in the stock exchange requirements.

Those measuring harmony at a point in time, or changes between the state of harmony between two points in time, use some form of frequency analysis. Van der Tas (1988 and 1992b) propagates the idea of indices, and meticulously develops the indices, H, C and I. These indices are mainly useful to measure material harmony. Tay and Parker (1990) favour the idea of statistical analyses, such as chi-square tests. More recently, Emenyonu and Gray (1992), appreciating the usefulness of both statistical analyses and indices, adopted both types of techniques. Their analyses clearly show that the two sets of techniques are complementary for the purpose of measuring material harmonisation.

Studies explaining the differences between accounting practices or regulations, or the influence of accounting variations on share prices and returns, adopt causal models such as regression. In the studies dealing with explaining the differences between practices or regulations, the aim is to identify the determinants of the variations in practice or regulations. In the case of the studies dealing with share price and return fluctuations, accounting practice and regulations are seen as the determinants of the observed phenomenon.

Judging from the important findings, strengths and weaknesses of the harmonisation studies, it is clear that harmonisation research has several dimensions. There are those studies that measure material harmony as an outcome of formal harmonisation; and those that explain the reasons for the state of formal harmony, and, more recently, market-based studies have extended research to understand the effects of material harmony on stock market indicators. Although harmonisation researchers should be commended for their ingenuity and resourcefulness, there are still many issues that need attention, one of which is the measurement of formal harmony — the theme of this research.

Tay and Parker (1990) observed that insufficient research had been done to date on the measurement of harmonisation. Walton (1992) and Emenyonu and Gray (1992) made observations that measurement studies have only been exploratory in nature. Emenyonu and Gray (1992) felt the need for comprehensive studies covering several accounting issues in all countries of a region or economic grouping. In this respect, this study is aimed at providing a means of comprehensively evaluating formal accounting harmony. The motivation of this study is also tuned within the objectives of a regional economic initiative, in that it exemplifies the manner in which formal harmony could be evaluated within the context of a particular setting.

This study provides for the measurement of differences between the requirements of two countries by accounting categories, generally specified by the countries being examined. Since in each category there are normally several subsets of requirements, the study illustrates the use of a multivariate statistical technique, the multiple discriminant analysis, to identify categories where similarities and dissimilarities exist. This technique allows for composite measures for each category.

3. Research design

The research design adopted in this study demonstrates the application of empirical analyses to measure formal accounting harmony. An attempt is made to conduct a detailed analysis of the state of formal harmony between two neighbouring countries, Australia and New Zealand.

There are two reasons for the choice of Australia and New Zealand for this study. First, cluster studies based on broad environmental or accounting practice variables have identified the two countries as members of the same country cluster (da Costa, Bourgeois and Lawson, 1978; Frank, 1979; Nair and Frank, 1980; Nobes, 1992). Broad comparisons of the accounting standards (Sharpe and McGregor, 1993a; 1993b) and detailed comparison of accounting regulatory mechanisms (Rahman, Perera and Tower, 1994) also confirm the view that, in general, the two countries' accounting regulatory environments are similar. The broad similarities between them will allow the results of the comparisons to be meaningfully interpreted. For example, since the two countries' regulatory systems are alike, similar requirements in an area would mean that the reporting entities in both countries are faced with analogous rules. In other words, similar requirements would indeed mean greater harmony. However, if the regulatory systems were very different, for instance if one country had government-backed standards and the other had non-binding professional guidelines, similar requirements in an area would not mean that material harmony is high, because variations in practice may still exist despite such formal harmony.

Second, growing business relations between Australia and New Zealand through the Closer Economic Relations (CER) efforts, strengthened by the similarities in their economic, legal and accounting infrastructures, have led to demands for uniformity in the two countries' regulations and regulatory mechanisms (Holmes et al., 1986; Lloyd, 1991). In the accounting domain, Australia's and New Zealand's professional bodies have shown great interest in recent years in harmonising their standards and practices. Increased participation in each other's activities, such as setting accounting standards and competency standards for professional accountants, clearly indicates their willingness to cooperate in achieving common objectives (Birkett, 1993; *New Zealand Herald*, 8 March 1989; Sharpe and McGregor, 1993a, 1993b; Hill, 1993). Such signals of close relations indicate that this study's results will be of use to policy-makers.

This study involves a comparison of all accounting requirements applicable to listed companies. These companies are important players in the international capital markets, and they are of immediate concern for the purposes of business regulation harmonisation under the CER Agreement (1993) between Australia and New Zealand (Reports to Governments by Steering Committee of Officials, 1992). However, the same analysis can be extended to include other types of business and non-business entities.

To make the comparison exhaustive, the disclosure and measurement requirements are matched separately. Another reason for the separation between the two types of requirement is that, of late, accounting policy-makers in Australia and New Zealand, like those of other Anglo-American countries, have seen more criticism in measurement areas than in disclosure. The separate comparisons would allow a clear exposure of measurement requirement differences.

The typology used for identifying the nature of the requirements is as follows:

Type 1. **Required** for all listed companies, i.e., requirements of the statutes, stock exchange listing requirements and accounting standards.

Type 2. **Recommended or suggested** by the statutes, stock exchange listing requirements, accounting standards, accounting guidelines (Australia) and technical practice aids (New Zealand).

Type 3. **Allowed or not required or not prohibited** by the above requirements.

Type 4. **Not permitted** by the statutes, stock exchange listing requirements or accounting standards.

A similar typology was used by Gray, Campbell and Shaw (1984) to identify the different types of requirement for disclosure and measurement. In this scheme all items of disclosure and measurement are given equal weight. There are certain categories of requirement (e.g., consolidation and fixed assets) that can be regarded as more important than others. These areas generally have a larger number of requirements. Therefore, for the purposes of analyses in this study, the weight of the importance of an issue is reflected through the number of items in a category of requirements.

The requirement for each item of disclosure and measurement using the above typology is considered to be providing discrete data. This is because the types of requirement identified do not represent a particular order of intensity in regard to accounting harmonisation. Although Types 1 and 4 requirements are coercive enough to create definite patterns of accounting practice, Types 2 and 3 requirements lack the strength to create such an impact. From the harmonisation viewpoint, if one country chooses to use Type 1 requirement for an accounting issue and the other chooses Type 4 requirement for the same accounting issue, then the outcome will invariably be disharmony for that issue. Conversely, if both countries choose either Type 1 or Type 4 requirement for an accounting issue, then the most likely outcome will be harmony. However, since both Types 2 and 3 requirements are of insufficient coercive influence for standardising practice, if the two countries choose to adopt any of these two types of requirements for an accounting issue, there will be ample room for disharmony in practice for that issue. The numbering of requirements does not imply that the data are ordinal in form in the sense of harmony. In other words, the data could be treated as discrete data, i.e., no particular strength attached to the difference between the two countries' observed requirements. Given that Types 1 and 4 requirements are of greater strength than Types 2 and 3 requirements, one could suggest that some form of weighting could be used to reflect this. However, no weighting procedure was used because such procedures themselves introduce subjectivity. Introduction of such subjectivity is evident from the multifarious interpretations of the Price Waterhouse International (1979) typology by Nobes (1981), Belkaoui (1983) and Cooke and Wallace (1990). Therefore, the requirements (the observations of this study) have been treated as discrete data of equal weight.

Tay and Parker (1990 and 1992) and van der Tas (1988 and 1992b) suggested the use of international harmonisation indices (C and I indices) for measuring the degree of accounting harmonisation between countries. These indices were meant for measuring de facto or material harmonisation, not de jure or formal harmonisation. The calculations of the indices require the information regarding the adoption of different accounting methods by different firms. This study, however, proposes to measure the similarities or differences in the two countries' disclosure and measurement requirements under the various categories mentioned above. In other words, it is an attempt to make an item by item comparison by relevant categories. This was achieved by applying the following statistical procedure.

Multiple discriminant analysis (MDA) was conducted to measure the level of harmony between the two countries' disclosure and measurement requirements, according to the categories in Table 1. For this analysis, the specific requirements under each category were seen as observations, and the categories as groups of observations. The concept of distance between groups of observations is often used as a measure of discrimination. The generalised distance analogous to the Mahalanobis distance, which has been shown to be fairly robust with discrete variables (Krzanowiski, 1988), was considered appropriate for this study because it focuses on identifying the varying differences between categories of attributes (i.e., measurement and disclosure requirements in this case). Krzanowiski (1988) points out that, since Mahalanobis distance is primarily defined for continuous variables, the use of the distance on discrete data should be treated purely in a descriptive fashion. In other words, all significance tests applied to this data must be treated with caution. Nevertheless, the Mahalanobis distance procedure computes distance measures between objects that are comparable to the R^2 in regression analysis (Hair et al., 1992).

Every observation within the categories has been re-expressed as a set of binary variables (with an abitrary scoring of 0 or 1) because it is easier to work with binary variables while applying Mahalanobis analysis on discrete variables (Krzanowiski, 1988). This conversion was performed on the data and then the Mahalanobis-like distances were calculated. It was decided to compute these distances between Australia and New Zealand for each category of requirements separately, so that discrimination for the different categories could be ranked accordingly.

To amplify the discrimination, the distances were supplemented by data regarding the number of exact matches between the two countries' requirements within each category. This matching process took into consideration what the requirements stated and their strength. The number of requirements in the different types of prescriptions for each category was also computed, to understand whether the strength of the requirements was a contributing factor in the variances.

In short, the research design is set up in a sequence that allows for the identification of (a) categories of requirement with variances between two countries, and (b) the degree of uniformity within each category to see if the variance is due to any mismatch of requirements. This is followed by an examination of whether the strength of the requirements was a contributing factor for the variance between the two countries. However, a detailed examination of the reasons for the differences between the requirements is outside the scope of this study.

4. Data

As a measure of comprehensiveness, the study includes all the three main sources of accounting regulation that affect listed firms, i.e., statutory requirements, stock exchange listing requirements and accounting standards. It is expected that this will provide for a more robust inquiry into the measurement of formal harmony between countries. The following sources of information were used to collect the necessary data for the two countries.

Australia:

1. CCH *Australian Corporations Law Guide*, 1993.
2. *Listing Rules* of the Australian Stock Exchange as at July 1993.
3. *1993 Model Financial Accounts* of the Centre for Professional Development (Australia).
4. *Members' Handbook*, as at December 1993, of the Australian Society of Certified Practising Accountants.

New Zealand:

1. Companies Act 1993.
2. Financial Reporting Act 1993.
3. CCH *Guide Book to New Zealand Companies and Securities Law*, 1990.
4. *New Zealand Stock Exchange Listing Requirements* as at May 1993.
5. *1993 Model Financial Statements* of the Centre for Professional Development (NZ) Ltd.
6. *New Zealand Accounting Standards* as at December 1993.

The categories of disclosure and measurement requirements are shown in Table 1. In preparing Table 1, an attempt has been made to maintain the same disclosure and measurement categories used in the three main sources of regulation.

In both New Zealand and Australia, the companies/corporations statutes and listing requirements provide only disclosure requirements, and accounting standards provide disclosure and measurement rules. Therefore, for disclosure categories, all relevant items as required by the companies/corporations statutes, listing requirements and accounting standards and their respective schedules were collected. For measurement categories, the accounting treatments of major items as laid out in the accounting standards were collected. Most items of information were clearly identifiable, and were categorised in a similar manner in the two countries. Nevertheless, there were some items that could not be matched directly. An effort was made to include such requirements of both countries under a representative category. For example, in classifying assets, a very broad category, i.e., non-current assets, is used in Australia. This category has been covered by several accounting standards in New Zealand. Therefore, the Australian category was broken down to match with the various categories identified in the New Zealand accounting standards, such as fixed assets and investment properties.

Furthermore, some refinements had to be made by creating a few additional categories for both countries, and eliminating duplication between categories that arose from some requirements being stated differently in different sources of regulation. The refinement process also included interviewing the financial accounts controllers of some of the New Zealand companies that were listed in both Australia and New Zealand to identify subtle differences between the two countries' requirements that the researchers could have overlooked. A total of 12 companies are currently listed on both New Zealand and Australian stock exchanges.[2] Nine of the 12 companies responded to the request for interviews. Two out of the nine that responded could not participate in the research because of their own time pressures, and one could not be scheduled for an interview because of the researchers' time constraints. Therefore, only six controllers could be interviewed.[3] The interviews were semi-structured, focusing on the issues of this research. This allowed the executives to bring in matters of concern that were initially not included in the research design.

With these refinements, 518 disclosure items spread over 31 categories and 469 measurement items spread over 28 categories were established.

5. Analysis and results

The following comparisons were conducted to identify and explain the similarities and differences between Australian and New Zealand disclosure and measurement requirements:

a) Disclosure requirements of:
    (i) accounting standards as at 30 October 1993;
    (ii) legislations as at 30 October 1993;

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[2] Although only 12 firms are listed in both countries, the number of firms that operate or are incorporated on both sides of the Tasman is much larger.

[3] The companies whose executives were interviewed are: Carter Holt Harvey Ltd.; Fletcher Challenge Ltd.; Heritage Mining; Lion Nathan Ltd.; New Zealand Oil and Gas; and Telecom New Zealand Ltd.

Table 1
Schedule of Disclosure and Measurement Categories

	Disclosure requirements
D1	General issues
D2	Profit and loss disclosures
D3	Other profit and loss items, i.e., to be disclosed through notes or as supplementary information
D4	Format of statements
	Balance sheet disclosures:
D5	Receivables
D6	Inventories
D7	Investments
D8	Property, plant and equipment
D9	Leases
D10	Intangibles
D11	Liabilities (current and non-current)
D12	Other disclosures with respect to liabilities
D13	Provisions
D14	Share capital
D15	Reserves
D16	Other supplementary disclosure with respect to assets and liabilities
D17	Accounting policy
D18	Foreign currency
D19	Segments
D20	Construction contracts
D21	Extractive industry
D22	Earnings per share
D23	Miscellaneous disclosure
	Group accounts
D24	Consolidated statements
D25	Equity accounting
D26	Joint ventures
D27	Partnerships
D28	Related party disclosures
	Cash flow information
D29	Cash flows related to operating activities
D30	Cash flows related to investing activities activities
D31	Cash flows related to financing activities

	Measurement requirements
M1	Fixed assets (New Zealand)/non-current Assets (Australia)
M2	Depreciation of fixed/non-current assets
M3	Leases
M4	Inventories
M5	Investment properties
M6	Properties intended for sale
M7	Joint ventures
M8	Partnerships
M9	Debt defeasance
M10	Set-off of debt
M11	Subsequent events
M12	Contingencies
M13	Research and development
M14	Expenditure carried forward
M15	Accounting for tax
M16	Extraordinary items and prior period adjustments
M17	Cash flow information
M18	Consolidation
M19	Foreign currency
M20	Segments
M21	Related party Disclosure
M22	Construction contracts
M23	Extractive industry
M24	Marketable securities
M25	Pensions
M26	Livestock
M27	Bloodstock
M28	Earnings per share

(iii) stock exchange listing requirements as at 30 October 1993;

(iv) accounting standards[4], legislative requirements and stock exchange listing requirements as at 30 October 1993, combined together.

b) Measurement requirements of accounting standards as at 30 October 1993.

Tables 2 to 6 provide the distance measures, the percentage of exact matches and items in each prescription type for Australia and New Zealand for the various requirements categories. The categories are listed in ascending order of distance between the two countries. Distance measures range from zero to infinity. The distance measures mean the extent of dissimilarity or likeness between Australia and New Zealand for each category of requirement. For example, a zero difference indicates that the two countries have uniform requi-

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[4] For the purpose of this study, the Australian accounting standards included standards approved by the Australian Accounting Standards Board, the standards endorsed by the Institute of Chartered Accountants of Australia and the Australian Society of Certified Practising Accountants, and the Australian Accounting Research Foundation's accounting guidelines. In terms of their strength, standards were seen as prescriptive and the guidelines as suggestive. The New Zealand accounting standards included all accounting standards and Technical Practice Aids of the New Zealand Society of Accountants. In terms of their strength, standards were seen as prescriptive and the practice aids as suggestive.

Table 2
Comparison of combined disclosure requirements of Australia and New Zealand

Disclosure requirements		*Items in each type of prescription*								*% of exact matches*	*Distance*
		New Zealand				*Australia*					
Category	*No. of items*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*		
D17	9	9	-	-	-	9	-	-	-	100.0	0.0000
D20	2	2	-	-	-	2	-	-	-	100.0	0.0000
D29	9	9	-	-	-	9	-	-	-	100.0	0.0000
D30	10	10	-	-	-	10	-	-	-	100.0	0.0000
D9	12	10	-	1	1	10	-	1	1	83.3	0.0000
D18	7	4	-	3	-	4	-	3	-	71.4	0.0000
D7	33	20	-	13	-	23	-	10	-	48.5	0.0356
D3	61	46	1	14	-	42	-	19	-	47.5	0.0635
D25	11	8	2	1	-	9	1	1	-	54.5	0.0660
D31	9	7	-	2	-	8	-	1	-	88.9	0.0808
D8	20	17	-	3	-	19	-	1	-	80.0	0.1086
D11	22	19	-	3	-	16	-	6	-	68.2	0.1123
D1	31	24	-	7	-	28	-	3	-	67.7	0.1229
D24	31	23	-	5	3	16	2	10	3	32.3	0.1229
D13	7	2	-	5	-	4	-	3	-	14.3	0.3117
D19	10	9	-	1	-	9	1	-	-	80.0	0.4000
D5	23	15	-	8	-	21	-	2	-	56.5	0.4251
D28	33	24	-	9	-	33	-	-	-	72.7	0.7273
D4	16	5	1	6	4	6	-	10	-	50.0	0.8784
D6	15	10	-	5	-	15	-	-	-	66.7	0.9333
D2	24	17	6	1	-	18	-	6	-	62.5	0.9583
D26	8	8	-	-	-	5	-	3	-	62.5	1.0500
D10	11	10	-	1	-	5	-	4	2	45.5	1.2024
D14	19	18	-	1	-	9	-	10	-	52.6	1.4211
D16	10	3	-	7	-	9	-	1	-	20.0	2.1600
D2	21	20	-	1	-	8	-	13	-	42.9	2.2120
D15	9	9	-	-	-	4	-	5	-	44.4	2.2222
D23	14	8	3	3	-	-	7	7	-	0.0	2.4762
D22	5	1	4	-	-	3	-	2	-	20.0	7.4667
D27	13	10	-	1	2	-	-	13	-	7.7	22.1539
D21	13	-	7	6	-	12	-	1	-	0.0	24.3077

Key
Type of prescription:
1. Required
2. Recommended or suggested
3. Allowed/permitted or not required
4. Not permitted

rements for the category concerned, whereas a very high distance figure represents a category that has two very different sets of requirements or an instance where one country has a set of requirements and the other has none. However, extremely large distance figures may also be unreliable. In such cases the covariances of the two sets of requirements, which were used as a denominator in the calculation of Mahalanobis distances, were too small to provide a precise measure. Distance figures greater than 99 have been stated as 99.0000 to keep the table columns up to six digits.

In the case of percentage of matches within each category (see '% of exact matches' column, Tables 2 to 6) the higher the percentage, the greater the level of uniformity for a category. However, exact matches do not, in all instances, mean that the two countries have the same requirements. The two countries' requirements are not always stated in the same manner or in the same parts of the corresponding documents stating the requirements. Many of the matches were observed only after the data were carefully refined to fit under the different items and categories of requirements. The matches, therefore, represent only the congruence between the two countries' requirements. Moreover, not all matches of requirements may lead to uniformity in practice. As mentioned earlier, only Types 1 and 4 requirements are coercive enough to have a definite influence on practice. Therefore, only if the requirements fall into these two types is there going to be a definite impact on material harmony. As already pointed out, weighting the requirements for their impact on actual practice is a subjective procedure, and has not been introduced into the computations. In this regard, as pointed out in the research design, the strengths of the requirements within a category for each coun-

Table 3
Comparison of Accounting Standards Disclosure Requirements

Disclosure requirements		*Items in each type of prescription*								*% of exact matches*	*Distance*
		New Zealand				*Australia*					
Category	*No. of items*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*		
D6	15	9	-	6	-	9	-	6	-	100.0	0.0000
D17	9	9	-	-	-	9	-	-	-	100.0	0.0000
D20	2	2	-	-	-	2	-	-	-	100.0	0.0000
D29	9	9	-	-	-	9	-	-	-	100.0	0.0000
D30	10	10	-	-	-	10	-	-	-	100.0	0.0000
D9	12	10	-	1	1	10	-	1	1	83.3	0.0000
D18	7	4	-	3	-	4	-	3	-	71.4	0.0000
D8	20	15	-	5	-	14	-	6	-	75.0	0.0120
D25	11	8	2	1	-	9	1	1	-	54.5	0.0660
D1	31	9	1	21	-	8	-	23	-	93.5	0.0731
D31	9	7	-	2	-	8	-	1	-	88.9	0.0808
D4	16	3	1	12	-	3	-	13	-	81.2	0.1260
D24	31	21	-	7	3	11	2	16	2	29.0	0.2790
D3	61	33	2	26	-	18	-	43	-	57.4	0.3744
D19	10	9	-	1	-	9	1	-	-	80.0	0.4000
D13	7	2	-	5	-	-	-	7	-	71.4	0.6857
D2	24	14	7	3	-	14	1	9	-	58.3	0.7099
D16	10	3	-	7	-	-	-	10	-	70.0	0.7714
D26	8	8	-	-	-	5	-	3	-	62.5	1.0500
D7	33	15	-	18	-	1	-	32	-	57.6	1.2587
D11	22	14	-	8	-	2	-	20	-	45.5	1.8086
D28	33	17	-	16	-	33	-	-	-	51.5	1.8253
D5	23	14	-	9	-	1	-	22	-	43.5	2.1845
D23	14	8	3	3	-	-	7	7	-	0.0	2.4762
D10	11	10	-	1	-	2	-	8	1	18.2	4.1897
D21	13	-	7	6	-	8	-	5	-	30.8	5.1077
D14	19	15	-	4	-	-	-	19	-	21.1	7.1053
D12	21	20	-	1	-	3	-	18	-	19.0	7.4389
D27	13	10	-	1	2	-	-	13	-	7.7	22.1539
D15	9	9	-	-	-	-	-	9	-	0.0	99.0000
D22	5	-	5	-	-	3	-	2	-	0.0	99.0000

try (see 'Items in each type of prescription' column of Tables 2 to 6) should be noted in examining the results of the matching procedure used in this study.

Table 7 summarises the more important aspects of the information in Tables 2 to 6. It provides the frequencies (by categories) of distances and exact matches between the disclosure and measurement requirements of the two countries.

The remaining discussion in this section shows how the statistics of the above analyses can be interpreted.

5.1. *Overall Disclosure Requirements*

The results of the comparison of the combined disclosure requirements of Australia and the combined disclosure requirements of New Zealand are shown in Tables 2 and 7. Of the 31 categories of disclosure, six categories indicated a 0.00 distance between the two countries. For 15 categories the distance was between 0.01 and 0.99, for eight categories it was between 1.00 and 19.99, and for the remaining two it was greater than 20.

The categories with large distances of over 20 were extractive industry accounting (D21)[5] and partnership accounting (D27). For extractive industries, Australia on the whole has more requirements, with an accounting standard supported by additional stock exchange requirements, while New Zealand does not have firm guidelines specifically aimed at the industry. Table 2 confirms this by showing that there are no matches between Australian and New Zealand requirements. There are 12 requirements in Australia on this matter, whereas New Zealand has only seven guidelines. This can be explained, at least partly, in terms of top companies' industrial characteristics in the two countries. As identified in Ryan (1992) and Ryan et al. (1991), in 1990 26% of the top Australian companies were engaged in mining and exploration activities, whereas the relevant figure for New Zealand was only 9%.

For partnership accounting, Australia has no requirements comparable to those of the New Zea-

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[5] Refers to the category serial number as itemised in Table 1.

Table 4
Comparison of Legislative Disclosure Requirements

Disclosure requirements		*Items in each type of prescription*								*% of exact matches*	*Distance*
		New Zealand				*Australia*					
Category	*No. of items*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*		
D17	9	-	-	9	-	-	-	9	-	100.0	0.0000
D18	7	-	-	7	-	-	-	7	-	100.0	0.0000
D19	10	-	-	10	-	-	-	10	-	100.0	0.0000
D20	2	-	-	2	-	-	-	2	-	100.0	0.0000
D21	13	-	-	13	-	-	-	13	-	100.0	0.0000
D22	5	-	-	5	-	-	-	5	-	100.0	0.0000
D23	14	-	-	14	-	-	-	14	-	100.0	0.0000
D25	11	-	-	11	-	-	-	11	-	100.0	0.0000
D26	8	-	-	8	-	-	-	8	-	100.0	0.0000
D27	13	-	-	13	-	-	-	13	-	100.0	0.0000
D29	9	-	-	9	-	-	-	9	-	100.0	0.0000
D30	10	-	-	10	-	-	-	10	-	100.0	0.0000
D31	9	-	-	9	-	-	-	9	-	100.0	0.0000
D1	31	12	-	19	-	11	-	20	-	77.4	0.0043
D9	12	-	-	12	-	1	-	11	-	91.7	0.1667
D28	33	9	-	24	-	16	-	17	-	78.8	0.1947
D24	31	1	1	29	-	6	1	23	1	74.2	0.2141
D3	61	4	-	57	-	15	-	46	-	75.4	0.2593
D12	21	-	-	21	-	5	-	16	-	76.2	0.5952
D14	19	-	-	19	-	6	-	13	-	68.4	0.8745
D15	9	-	-	9	-	3	-	6	-	66.7	0.8889
D4	16	1	1	10	4	4	-	12	-	50.0	1.0135
D10	11	-	-	11	-	4	-	6	1	54.5	1.5152
D8	20	-	-	20	-	10	-	10	-	50.0	1.9000
D2	24	-	-	24	-	13	-	11	-	45.8	2.2652
D13	7	-	-	7	-	4	-	3	-	42.9	2.2857
D11	22	-	-	22	-	12	-	1	-	45.5	2.2909
D7	33	-	-	33	-	19	-	14	-	42.4	2.6320
D16	10	-	-	10	-	8	-	2	-	20.0	7.2000
D5	23	-	-	23	-	20	-	3	-	13.0	12.7536
D6	15	-	-	15	-	14	-	1	-	6.7	26.1333

land accounting standard. This is also reflected in the fact that the percentage of exact matches was a mere 7.7. Another item where there is a large distance is earnings per share (D22). Here, New Zealand lags behind Australia by having only a technical practice aid instead of a standard, and with only one stock exchange disclosure requirement.

An interesting item to note is miscellaneous disclosures (D23). This is basically a group of items of lesser importance where both countries mainly have guidelines, practice aids or short standards. The fourth highest distance (2.4762; Table 2) is in this area. This is because the two countries seem to have variations in these, presumably, fringe areas which in most cases reflect the individual country's traits. For example, New Zealand has requirements on goods and services tax because of its regime on that issue (whereas Australia has no such requirements), and Australia has guidelines on capital gains accounting because of its capital gains tax regime (whereas New Zealand has no such guidelines).

5.2. Disclosure Requirements in Accounting Standards

The greatest amount of variation in distances seems to exist in the case of accounting standards (see Table 7). For accounting standards among the 31 categories of requirements only seven had zero distances; 11 had between 0.01 and 0.99 distances; 10 had between one and 19.99 distances; and three had above 20 distances.

Among the accounting standards' disclosure requirements, the greatest differences were found in earnings per share (D22), reserves (D15) and accounting for partnerships (D27) (Table 3). For both reserves and partnerships, New Zealand has standards covering them, with nine and 10 requirements, respectively, whereas Australian standards are silent on these issues. For earnings per share, the difference is because Australia has a standard with three requirements, whereas New Zealand has a technical practice aid with five guidelines, indicating that one has stricter requirements than the other.

Table 5
Comparison of Stock Exchange Disclosure Requirements

Disclosure requirements		*Items in each type of prescription*								*% of exact matches*	*Distance*
		New Zealand				*Australia*					
Category	*No. of items*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*		
D2	24	15	-	9	-	15	-	9	-	100.0	0.0000
D4	16	4	-	12	-	4	-	12	-	100.0	0.0000
D5	23	3	-	20	-	3	-	20	-	100.0	0.0000
D6	15	1	-	14	-	1	-	14	-	100.0	0.0000
D7	33	11	-	22	-	11	-	22	-	100.0	0.0000
D8	20	3	-	17	-	3	-	17	-	100.0	0.0000
D9	12	-	-	12	-	-	-	12	-	100.0	0.0000
D10	11	-	-	11	-	-	-	11	-	100.0	0.0000
D11	22	6	-	16	-	6	-	16	-	100.0	0.0000
D12	21	-	-	21	-	-	-	21	-	100.0	0.0000
D13	7	-	-	7	-	-	-	7	-	100.0	0.0000
D14	19	9	-	10	-	9	-	10	-	100.0	0.0000
D15	9	1	-	8	-	1	-	8	-	100.0	0.0000
D17	9	3	-	6	-	3	-	6	-	100.0	0.0000
D18	7	-	-	7	-	-	-	7	-	100.0	0.0000
D19	10	1	-	9	-	1	-	9	-	100.0	0.0000
D20	2	-	-	2	-	-	-	2	-	100.0	0.0000
D23	14	-	-	14	-	-	-	14	-	100.0	0.0000
D24	31	6	-	25	-	6	-	25	-	100.0	0.0000
D25	11	-	-	11	-	-	-	11	-	100.0	0.0000
D26	8	-	-	8	-	-	-	8	-	100.0	0.0000
D27	13	-	-	13	-	-	-	13	-	100.0	0.0000
D28	33	-	-	33	-	-	-	33	-	100.0	0.0000
D29	9	91	-	-	-	9	-	-	-	100.0	0.0000
D30	10	0	-	-	-	10	-	-	-	100.0	0.0000
D3	61	15	-	46	-	16	-	45	-	95.1	0.0014
D31	9	7	-	2	-	8	-	1	-	88.9	0.0808
D1	31	19	-	12	-	24	-	7	-	71.0	0.1222
D16	10	-	-	10	-	1	-	9	-	90.0	0.2000
D22	5	1	-	4	-	-	-	5	-	80.0	0.4000
D21	13	-	-	13	-	5	-	8	-	61.5	1.1539

Distances also seem to be high for share capital (D14), extractive industries (D21), intangibles (D10) and other disclosures with respect to liabilities (D12). Except for extractive industries, in the other three categories New Zealand standards seem to have a higher number of requirements than Australian standards (Table 3). However, the legislative requirements and/or the stock exchange requirements in Australia seem to fill in, to some extent, for the lack of accounting standards in these areas. For extractive industries, Australia not only has a standard as compared to a weaker technical practice aid in New Zealand, it has more requirements as well.

5.3. Legislative Requirements for Disclosure

For legislative requirements, 13 categories had zero distances; eight had between 0.01 and 0.99 distances; nine had one to 19.99 distances; and only one had above 20 distance (Table 7). Inventories (D6), receivables (D5) and other supplementary disclosures with respect to assets and liabilities (D16) seemed to be the areas of high difference (Table 4). In all these cases, Australia had more requirements than New Zealand. Closer scrutiny of observations indicated that for inventories and receivables, New Zealand's void in legislative requirements was filled by its accounting standards. In the case of other disclosure requirements, Australia had provisions for additional disclosure with respect to expenditure commitments, leases and contingencies. These items were, however, covered in New Zealand by the accounting standards.

5.4. Stock Exchange Listing Requirements for Disclosure

The stock exchange requirements seemed to have the least variances, with 25 out of 31 categories having 0.00 distances, and the highest distance being only 1.15385 (Table 5). The number of categories with 100% matching between the stock exchange requirements of the two countries is 25 and not less than 60% matching in any of the other six categories. In effect, the two countries' stock exchange requirements were almost identical.

Table 5 shows that extractive industries is the area with the highest amount of variance among

Table 6
Comparison of Accounting Standard Measurement Requirements

Disclosure requirements		*Items in each type of prescription*								*% of exact matches*	*Distance*
		New Zealand				*Australia*					
Category	*No. of items*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*		
M7	10	8	-	-	2	8	-	-	2	100.0	0.0000
M20	18	10	3	-	5	10	3	-	5	100.0	0.0000
M17	24	20	-	2	2	19	1	3	1	87.5	0.0000
M22	9	6	-	3	-	6	-	5	-	33.3	0.0000
M4	30	4	12	8	6	8	9	5	8	66.7	0.0100
M18	51	41	3	2	5	40	3	-	8	80.4	0.0300
M2	28	9	3	10	6	11	2	10	5	67.9	0.0300
M11	9	7	1	-	1	5	2	2	-	44.4	0.0800
M3	26	20	2	4	-	22	-	4	-	69.2	0.1600
M9	18	17	-	1	-	14	2	2	-	83.3	0.3000
M19	30	21	-	3	6	20	2	-	8	66.7	0.3700
M14	14	4	-	8	2	5	1	4	4	71.4	0.4600
M23	21	-	14	6	1	11	3	2	5	19.0	0.5000
M15	14	11	-	2	1	8	-	6	-	71.4	0.5300
M13	14	9	1	-	4	9	4	-	1	64.3	0.5500
M1	46	27	5	9	5	17	1	24	4	43.5	0.5800
M10	10	10	-	-	-	7	1	2	-	70.0	0.7700
M21	5	5	-	-	-	3	2	-	-	60.0	1.0700
M12	12	4	-	7	1	-	-	12	-	58.3	1.3100
M16	11	10	-	-	1	5	-	5	1	54.5	1.5800
M24	10	1	-	3	6	-	5	-	5	40.0	2.5800
M8	10	5	-	3	2	-	-	10	-	30.0	2.5800
M26	7	-	5	2	-	-	-	7	-	28.6	4.2000
M6	9	9	-	-	-	2	-	7	-	22.2	4.2900
M5	12	10	2	-	-	1	-	11	-	8.3	20.5300
M25	7	-	-	7	-	7	-	-	-	0.0	99.0000
M28	10	-	10	-	-	-	-	10	-	0.0	99.0000
M27	4	-	4	-	-	2	-	2	-	0.0	99.0000

Table 7
Distance Intervals and Proportionate Number of Matches Between the Disclosure and Measurement Requirements of Australia and New Zealand

	Disclosure requirements (number of categories)				*Measurement Requirements (number of categories)*
	Combined	*Accounting standards*	*Legislative*	*Stock exchange*	
Distance intervals					
00	6	7	13	25	4
0.01-0.99	15	11	8	5	13
1.00-19.99	8	10	9	1	7
>20	2	3	1	0	4
Proportionate number of matches					
>50% of the items	18	20	22	31	16
<50% of the items	13	11	9	0	12

all stock exchange rules. However, Table 5 also shows that the two countries' stock exchanges do not provide requirements for many items of disclosure under several categories, thereby contributing very little towards harmonisation.

Tables 3, 4 and 5 reveal that the legislatures and the stock exchanges prescribe requirements in fewer categories than accounting standards. The variance in the range of distances for the three sources of regulation seems to be positively associated with the extent of coverage of the categories by each of the sources.

5.5. Measurement Requirements

The analysis of the measurement requirements (see Table 6) shows that out of the 28 categories of requirement, four indicate no or very little difference between Australia and New Zealand; 13 indicate a distance of 0.01 to 0.99; seven indicate a distance of one to 19.99; and only four exceed a distance of 20.

The categories with high distances were bloodstock (M27), earnings per share (M28), pensions (M25) and investment properties (M5). For bloodstock accounting, Australia has a complete void, with New Zealand having a technical practice aid to cover the issue. As indicated in Ryan (1992) and Ryan et al. (1991), in 1990 7% of top New Zealand companies were engaged in frozen meat and byproducts, whereas none of the top Australian companies had this as their area of business. For earnings per share, Australia has a standard with more specific requirements, while New Zealand has a technical practice aid that only provides broad guidance. For pension accounting, New Zealand has yet to make a move to provide some guidance, whereas Australia has already issued a standard. For investment properties, New Zealand has a standard but Australia has not made any serious attempt at one. A similar situation exists for properties intended for sale, as indicated by a distance of 6.22. In both these cases, Australia has made only broader guidelines within its non-current assets standard. This again is reflected in the industrial characteristics of the two countries' large companies. Proportionately more New Zealand top companies were in property business (7%) compared with their Australian counterparts (4%) (Ryan, 1992; Ryan et al., 1991).

Table 7 shows that 50% or less exact matching of the regulatory provisions within each category of disclosure and measurement rules is quite common. For the comparison of the two countries' combined disclosure requirements, in 13 out of 31 categories there is 50% or less exact matches. For accounting standard disclosure requirements, matches of 50% or less exists for 11 out of the 31 categories. For legislative requirements, there are nine such categories, with the stock exchange requirements having no such categories. For measurement requirements such mismatches exist for 12 out of 28 categories.

Further scrutiny of the 'Items in each type of prescription' column of Tables 2 and 6 reveals that a lot of the matches between the requirements could have arisen due to the presence of Types 2 and 3 requirements. This is especially evident in Table 5 for stock exchange requirements. This leaves room for diversity in reporting practices.

6. Conclusions

This paper proposed to demonstrate the use of a research design that allows for the measurement of formal accounting harmonisation across countries. This has been achieved by a statistical-empirical comparison between the measurement and disclosure requirements for Australian and New Zealand listed companies.

The methodology adopted here provides several benefits. It allows for the identification of accounting areas where formal disharmony exists. The logic behind the calculations is fairly simple because it only involves calculation of distances between the countries for each category of requirement, through a process of matching the individual items of requirement under each category. The matching of items also provides an insight into the nature of variances between the rules of two countries. For instance, it identifies the extent of uniformity (exact matches) between the requirements of two countries. It allows for the discovery of possible material disharmony despite the existence of similar rules, which can occur due to rules of dissimilar strengths. Such an appraisal of accounting rules can assist accounting policy-makers at both regional and global levels in targeting areas needing greater attention for harmonisation purposes. For example, an application of a similar type would be useful for the IASC's comparability project or the European Union's harmonisation project. The discrimination between different countries' rules can also be correlated with other environmental characteristics to identify the reasons for the variations in specific categories of rules. This may help in determining appropriate courses of action to achieve formal harmonisation in targeted areas.

The research methodology presented here opens up several research directions. For example, the distances computed in this study can be correlated with the differences in actual practice to see how much of the material harmony is explained by regulatory arrangements. For instance, if no significant correlation is found between the two, then achievement of formal harmonisation may not lead to material harmonisation. Similar tests may also be conducted to understand the association between share price variations and formal harmonisation.

In addition to the type of research demonstrated here, other forms of research, such as those involving interviews, case studies or surveys, may be necessary to fully understand the underlying or subtle issues surrounding formal accounting harmonisation. Presence of such issues was encountered in the brief interviewing process used in this study. The interviews showed that, apart from the variations in the rules, there were variations in the format and language in which the rules are presented, and the frequency of reporting required by certain authorities within the two countries for certain qualitative information. These, the interviewees felt, affected material harmonisation.

Finally, because of the growing influence of accounting regulations on accounting practice and market indicators, it is essential that formal accounting harmonisation be more carefully and extensively examined to make material harmonisation effective. The rapid expansion of global and regional market systems is making research in this area more pertinent. The need for such research is also becoming more critical as a result of the proliferation of national accounting regulatory systems. In this respect, this study has only touched a vast area of research. Although it has covered only two countries and listed companies, similar studies using the multiple discriminant analysis methodology can be conducted on more than two countries at a time and on other forms of organisations.

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Why Managers Use Cost Allocations: A Research Note

Marc J.F. Wouters*

Abstract—Using an experimental design, this paper investigates empirically the conditions under which managers use cost allocations for decision-making purposes. The paper focuses on decision-risk in the context of short-term decision-making when most capacity costs are unavoidable. Decision-risk is determined in this paper by a combination of two factors: uncertainty and irreversibility. Cost allocations can serve as a reference point for a decision-maker to deal with decision-risk. Three hypotheses are formulated: (1) the combination of both uncertainty *and* decision irreversibility induces the use of cost allocations. However, (2) certainty *or* (3) decision reversibility alone are not expected to induce the use of cost allocations. The hypotheses were tested in an experiment, in which senior managers participated. The experimental results supported the hypotheses.

1. Introduction

This paper tries to explain why managers find it useful to allocate capacity costs for decision-making purposes. Empirical evidence suggests, for example, that in many cases managers determine selling prices using full costs (e.g., Govindarajan and Anthony, 1983; Cooper, Falk and Miller, 1981; Mills, 1988; Drury and Tayles, 1992). Full costs appear to play a major role in other decisions, such as product introduction, make or buy, product abandonment, etc (e.g., Emore and Ness, 1991; Gambino, 1980; Lambert, 1985). This paper formulates and tests empirically a theory suggesting that uncertainty and decision irreversibility, which are two factors affecting decision-risk, are among the important causes of the use of full costs.

In the accounting literature, it has been suggested that the often uncertain environment in which decisions must be made explains the use of full costing procedures. The effectiveness of an incremental costing procedure crucially depends on the estimation of opportunity costs, which is particularly difficult in this setting. Instead of trying to estimate opportunity costs directly, full costs serve as an approximation of opportunity costs, and this could explain the actual use that managers make of full costing procedures. (See Zimmerman, 1979; Miller and Buckman, 1987; Stidham, 1992.)

The present paper, however, does not address the question of whether full costing procedures approximate opportunity costs. We investigate how managers use cost allocations to make decisions that seem 'best' to them. Such decisions may or may not be profit-maximising decisions. The present paper focuses on an important example of cost allocations—the allocation of capacity costs.

2. Theory and hypotheses

This paper focuses on the allocation of capacity costs. The following situation is studied: a manager has the choice between either accepting a given activity which yields a known contribution margin, or rejecting it and trying to obtain a higher contribution margin from an alternative activity. Among the important causes of the use of full costing in such a setting are uncertainty and decision irreversibility, which are two factors jointly affecting decision-risk.

If there is no decision-risk, because there is certainty about the value of both alternative courses of action that are open to the manager, it is easy to make a decision based on incremental costs and revenues. In that case, full costing is not expected. Furthermore, there is no decision-risk if the activity under consideration is reversible, which means that it can be discontinued at any time without penalty costs (other than giving up the contribution margin of the remaining part of the activity). Again, full costing is not expected. For a review of the literature on the effects of (ir)reversibility, see Pindyck (1991). The following two hypotheses are formulated:

> **Hypothesis 1. If there is certainty, then managers are not expected to follow a full-cost approach.**

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*The author is at the University of Limburg and Moret Ernst & Young. He is grateful for comments on earlier versions of this paper by Ken Merchant, Peter Brownell, participants of a workshop at Lancaster University, and the anonymous reviewers. Correspondence should be addressed to University of Limburg, Faculty of Economics and Business Administration, Maastricht Accounting and Auditing Research Centre, P.O. Box 616, 6200 MD Maastricht, The Netherlands. This paper was submitted in March 1995 and accepted in March 1996.

Table 1
Distribution of Decisions Among the Experimental Conditions

	Certainty	*Uncertainty*
Reversibility	0	2 cases = 4 versions, each used 12 times→48 decisions
Irreversibility	4 cases = 8 versions, each used 12 times→96 decisions	4 cases = 8 versions, each used 18 times→144 decisions

Hypothesis 2. If the activity is reversible, then managers are not expected to follow a full-cost approach.

There is decision-risk if there is uncertainty (which means that every decision could prove to be wrong in retrospect) *and* the activity is irreversible (which means that a wrong decision cannot be adjusted). Uncertainty can relate to any of the relevant matters involved in making capacity utilisation decisions; in this paper it is not certain whether another activity which, in fact, yields a higher contribution margin will be obtainable. If this is not the case, then a zero contribution margin is obtained. If the given activity is accepted, it cannot be discontinued. There is irreversibility. The decision-maker has the choice between a sure alternative (accepting) and a risky alternative (trying to obtain a better option).

In this context of uncertainty and decision irreversibility, we assume that managers who are provided with allocated cost data would use these data in such a way as to reject some activities and accept others: (i) if the contribution margin of an activity is insufficient to yield a satisfactory profit margin, the manager will be more likely to take some risks (and reject the sure contract); and (ii) if the contribution margin of an activity is sufficient to generate a satisfactory profit margin, then the manager will be more likely to avoid risks (and accept the sure contract).[1]

Hypothesis 3. If there is uncertainty and the activity is irreversible, then managers are expected to follow a full-cost approach.

3. Experiment

3.1. Design and Subjects

An experiment was used to test whether a full-cost approach would be followed, depending on (un)certainty and decision (ir)reversibility, as specified by the hypotheses. Subjects were experienced managers working in industry, 70% of whom had a general management position, and 80% at least 10 years' management experience. The use of 'real' managers in experiments has been advocated by Griffin and Kacmar (1991). Subjects were given decision problems ('cases') and had to make one decision for each case. This decision concerned whether to accept a contract for producing and selling a certain amount of a particular product. Capacity was available to accept the contract, and the contribution margin of the contract was positive. Seventy-two subjects were given four different cases, so 72 × 4 = 288 decisions were made. Of the four cases presented to each subject, two cases related to Hypothesis 3 and two cases related to either Hypothesis 1 (48 subjects) or Hypothesis 2 (24 subjects). Assignment of cases to subjects was random. The distribution of the 288 decisions among the experimental conditions is clarified in Table 1.

For every case, there were two versions, one with a negative profit margin and one with a positive profit margin. It was assumed that subjects would consider a negative profit margin to be unsatisfactory and a positive profit margin to be satisfactory. A subject was given only one version of a particular case, and decisions for both versions of a case were compared across subjects. A full-cost approach would mean that the profit margin being negative or positive would make the managers reject or accept the contract respectively. A Fisher's Exact test (one-tail) was used to determine whether the decisions (accept versus reject) for the negative profit margin were significantly different from the decisions for the positive profit margin. Each subject received two positive and two negative profit margin cases.

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[1] The use of cost allocations as a reference point is based on prospect theory (Kahneman and Tversky, 1979). Prospect theory has been applied previously in a variety of contexts to explain actual decision-making processes: taxpayer decisions on income reporting (e.g., Chang et al., 1987; Schadewald, 1989; Schepanski and Kelsey, 1990; Robben, 1991); standard-setting in participative budgeting (e.g., Van de Poel, 1986; Kim, 1992); selection of projects (e.g., Harwood et al., 1991); variance investigation decisions (Lipe, 1993); buying decisions (e.g., Puto, 1987); decisions in stock trading (e.g., Shefrin and Statman, 1985); decisions on project abandonment and escalation of commitment (e.g., Arkes and Blumer, 1985; Bazerman, 1984; Brockner, 1992; Northcraft and Neale, 1986; Staw and Ross, 1987; Whyte, 1986); and information purchasing strategies (e.g., Bowen and Qiu, 1992).

3.2. *Materials*

Uncertainty was constructed in the following way: no other specific contracts with higher contribution margins were given, but it was left unclear whether a contract with a higher contribution margin could perhaps be obtained. There was also uncertainty about whether capacity costs could be avoided if the contract was not taken.[2] In the certainty case, it was stated that it was certain that no better contracts would be available.[3] This manipulation is in contrast to many experiments reported in the literature where subjects are given simple choice problems with known outcomes and probabilities (e.g., Thaler and Johnson, 1990; Kim, 1992; Kahneman and Tversky, 1979; Sullivan and Kida, 1995). In the experiment described here, alternative outcomes and the probabilities of obtaining these outcomes were not provided, since in practice such information is usually not available. Uncertainty in practice often only means that a manager knows that better contracts may or may not be available.

Irreversibility was constructed as follows: irreversibility meant that the contract was binding for two years; reversibility meant that the contract was not binding and could be discontinued without penalty costs.[4] In most cases, the project would continue to be available to the company for the next six months. Some contextual information about the companies was also provided (products, previous year's total sales and profit, number of employees, exports). Full texts of all cases are available to readers on request.

Each hypothesis was tested using several cases. These are not independent tests, since a subject received two cases testing the same hypothesis. Each manager was given four cases concerning four different companies:

- a company producing glass products such as bottles, jars, vases and bowls;
- a company supplying transport and distribution services;
- a company producing metal products and specialising in very accurate sheet metal cutting;
- a company producing passive electronic components.

Other differences between the cases concerned the continuity of the contract and the time available for considering the contract.

3.3. *Procedure*

Eighty-one managers were asked to participate. Most of these were suggested by members of the university staff. Seventy-two managers agreed to participate. For 68 subjects the experiment was performed at their own office, for the other four, it was performed in an office at the university. The experiment took between 45 minutes and an hour and there were no interruptions during the sessions.

With real managers participating, there was a chance that the 'experimental' or 'theoretical' nature of the task would irritate them. To prevent this, the researcher was very explicit about the task when the managers were approached and instructed. It was made clear that they had to make a decision in a fictitious situation and that decision-making in their normal function would not be part of the experiment. Also, the researcher wanted to prevent the undesirable atmosphere of an individual 'test' or 'examination', and was therefore present during the experiment. No additional verbal information was provided during the session. The researcher had the opportunity to check whether a subject was irritated and if s/he took the task seriously.

3.4. *Results*

H1: If there is certainty, then managers are not expected to follow a full-cost approach. To test this hypothesis, four cases were used.[5] As explained in a preceding section, a full-cost approach means that the decisions for the version with the negative profit margin are significantly different from the decisions for the version with the positive profit margin. This was tested using a Fisher's Exact test (one-tail). The results are given in Table 2. Significance is 0.24, 0.11, 0.50 and 0.50, and it is concluded that for all cases the profit margin had no significant influence on the decisions made. It can be concluded that the managers did not follow

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[2] For example, this was formulated in one of the cases as follows: 'At this moment your company has idle capacity which is sufficient to accommodate the production for this contract. Because of your flexible technical capabilities, it is uncertain whether other alternatives for utilising the idle capacity will be available. Better contracts may or may not be available in the near term.'

[3] As an example, in one of the cases it was stated that: 'Your company has about 2% idle capacity with which the contract can be realised. Therefore, no additional fixed costs are incurred if you accept this contract. The reason for this idle capacity is a structural market decline which took place after you had invested in the present production capacity. It is not possible to reduce the present level of fixed costs. The market is transparent to the extent that it is apparent that other, more attractive contracts, cannot be found.'

[4] For example, irreversibility in one case meant: 'Your company has the opportunity to supply certain glass products to a major producer of tableware. This customer follows a policy of co-makership and wants to conclude a binding contract for two years.' In another case reversibility meant that: 'Your company can enter into a contract with a manufacturer of furniture. This manufacturer has not yet decided how the warehousing of finished products will be handled in the future. Therefore, the contract is formulated in such a way that both parties can terminate the contract unilaterally.'

[5] These are not independent tests, as explained in Section 3.2, 'Materials'.

Table 2
Results of Four Cases Testing Hypothesis 1

	Number of times NOT accepting	*Number of times accepting*
Case 1a, $p=0.24$:		
Negative profit margin	2	10
Positive profit margin	0	12
Case 1b, $p=0.11$:		
Negative profit margin	3	9
Positive profit margin	0	12
Case 1c, $p=0.50$:		
Negative profit margin	1	11
Positive profit margin	0	12
Case 1d, $p=0.50$:		
Negative profit margin	1	11
Positive profit margin	2	10

a full-cost approach under conditions of certainty. These results supported Hypothesis 1.

H2: If the activity is reversible, then managers are not expected to follow a full-cost approach. Hypothesis 2 was tested using two cases. Results are presented in Table 3 (the results are identical for both cases). Significance is 0.30, so the profit margin had no significant influence on the decisions made. It can be concluded that the participating managers did not follow a full-cost approach when deciding about reversible activity. The results supported Hypothesis 2.

H3: If there is uncertainty and the activity is irreversible, then managers are expected to follow a full-cost approach. This hypothesis was tested using four cases. The results are in Table 4. Significance is 0.038, 0.008, 0.022, 0.002; thus, whether the profit margin was negative or positive had a significant influence on the participating managers' decisions. It can be concluded that these managers followed a full-cost approach when deciding about an irreversible activity under uncertainty. Hypothesis 3 was supported.

4. Discussion and conclusions

A weakness in the experimental design used is that no systematic manipulation checks were used. From talking to the subjects after the experiment, and by listening to them during the experiment, it appears that some subjects were not convinced by certainty in combination with a negative profit margin.

A limitation of the paper is that only segregated framing of capacity utilisation decisions has been discussed. However, at some point a manager is presumably going to see total profits for the business unit (all activities) and evaluate that figure. It is possible that the choice at this level will not be the same as the choice based on segregated evaluation of activities. The same problem can be framed differently, and this potential conflict is a limitation of the present paper. Future research could be aimed at the conflict between segregation versus aggregation as part of the framing problem.

To conclude, this paper discusses the use of cost allocations for decision-making. The discussion

Table 3
Results of Two Cases Testing Hypothesis 2

	Number of times NOT accepting	*Number of times accepting*
Case 2a, $p=0.30$:		
Negative profit margin	3	9
Positive profit margin	1	11
Case 2b, $p=0.30$:		
Negative profit margin	3	9
Positive profit margin	1	11

Table 4
Results of Four Cases Testing Hypothesis 3

	Number of times NOT accepting	*Number of times accepting*
Case 3a, $p=0.038$:		
Negative profit margin	9	9
Positive profit margin	3	15
Case 3b, $p=0.008$:		
Negative profit margin	11	7
Positive profit margin	3	15
Case 3c, $p=0.022$:		
Negative profit margin	12	6
Positive profit margin	5	13
Case 3d, $p=0.002$:		
Negative profit margin	11	7
Positive profit margin	2	16

has focused on one important example—the allocation of capacity cost for acceptance decisions on the utilisation of capacity. The conditions under which managers follow a full-cost approach have been investigated, using an experimental design. The results support the theory that decision-risk is an important explanation for the use of a full-cost approach. A combination of uncertainty and irreversibility creates decision-risk, and in such situations the evaluation of alternatives depends on the after-allocation profit margin of each alternative.

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Neural Networks and Empirical Research in Accounting

Duarte Trigueiros and Richard Taffler*

Abstract—This article seeks to provide an overview of the potential role of neural network (connectionist) methodology in empirical accounting research. It highlights how the accounting task domain differs substantially from those for which neural network techniques were originally developed. A non-technical overview of neural network methodology is given, along with guidelines to help accounting researchers interested in applying these new tools to recognise the potential dangers and strengths underlying their use. An illustrative example is provided. The paper suggests research areas in accounting where neural network approaches could make a potential contribution. Explicit recommendations for prospective authors are made.

1. Introduction

Statistical modelling plays an important role in accounting research. This paper is concerned with the potential application of neural networks (connectionist models) in accounting research in the light of recent claims that such methodologies can out-perform traditional statistical approaches.

The majority of neural network studies in the business area to date have been classical financial forecasting applications.[1] Accounting applications are more limited and tend to be of a classification nature, applying neural network methodology in areas already well served by conventional statistical techniques, where the main concern is the comparative performance of the new methodology.[2]

In addition, much of this work appears in non-accounting and non-finance journals, is undertaken by computer scientists and engineers, and is in case study form (Hill et al., 1994, p. 11). Authors typically claim that neural network models out-perform conventional statistical techniques, although such comparative studies often do not use best practice in their statistical modelling (Chatfield, 1993).

This paper considers whether connectionist models are an appropriate tool for analysing accounting data and, if so, in which areas they can be most usefully applied. The next section provides a framework for comparing connectionist (pattern recognition) and accounting research task domains, and this is followed by a brief non-technical overview of neural network methodology. To illustrate the dangers of uncritical application of the technique, a review of applications in one widely addressed area, corporate failure prediction, in comparison with conventional multivariate approaches, is next undertaken. The paper then considers important methodological issues and reviews areas in empirical accounting research where neural networks may have the potential to contribute usefully. The concluding section gives advice to prospective authors.

2. A framework for comparison

Neural networks were originally developed to deal with problems in artificial intelligence such as speech, text and other pattern-recognition tasks, which conventional computing approaches were unable to solve. More recently, connectionist models have also been widely applied in such areas as defence and medicine, but in the same pattern recognition context. Are the distinguishing characteristics of the task domains where neural networks succeed a recommendation for using them in social science research?

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[1] See Hill et al. (1994); Trippi and Turban (1993); and Refenes (1995) for reviews. Finance-orientated studies of more potential relevance to accounting researchers are, for example, in the prediction of option prices (Baestaens et al., 1994, ch. 5), the modelling of arbitrage pricing theory stock returns (Refenes, 1995, ch. 7) and the prediction of stock price performance (Kryzanowski et al., 1993 and Yoon et al., 1993).

[2] Outside the well-explored failure prediction domain, neural network methodology has also been applied in the accounting area, for example, to the going concern qualification decision (Coats and Fant, 1993), bond rating (Singleton and Surkan, 1995), credit scoring (Jensen, 1992), audit litigation and audit opinion giving (Hansen et al., 1992), the analytical review process (Coakley and Brown, 1993) and the prediction of mergers (Sen et al., 1995).

Table 1
Five Comparative Characteristics of Pattern Recognition and Accounting Task Domains

Task domain	*Characteristics*				
	Complexity of the relationship	*Underlying theory describing the relationship*	*Number of explanatory variables*	*Variability explained (R^2)*	*Size of available samples*
Pattern recognition	Very complex (highly interactive and non-linear)	Well-established	Small: three or fewer	High	As large as required
Accounting	Typically simple	Often competing or weak	Often five or more	Generally low	Often limited

Table 1 lays out five important characteristics that differentiate pattern recognition and accounting relationships: complexity of the functional form, existence of underlying theory, proportion of the variability generally explained by the fitted model, minimum number of independent variables required to specify the relationship, and availability of large samples for model building.

The major obstacle in such problems as speech and text recognition is complexity, since the underlying theoretical constructs are well-established and variable explanatory power is large. In contrast, accounting data may be characterised by simple functional forms and missing (unknown or unmeasurable) variables, and theory may be weak. Explanatory power, although significant, is often low.

The last distinguishing aspect, the availability of large samples, is especially important. In pattern recognition, as in other experimental sciences, samples of required size can be generated artificially. Not so in the social sciences, where samples are in general small and case data cannot be simulated. This gravitates against trying to fit complex relationships between dependent and independent variables.

As such, pattern recognition and empirical accounting research may be viewed as quite distinct cognate areas. How can we usefully apply neural networks, developed to deal with problems in one discipline, to the other? Does the ability of neural network methodologies to model complexity, which is their main strength, entail danger when applied to simple relationships where variables may have low explanatory power?

3. Inside neural networks

There are many types of neural network; we focus here on the technique principally used in the accounting and finance literature, the 'multilayer perceptron' (MLP).[3]

Conventional linear or generalised linear modelling tools such as logistic regression or linear discriminant analysis derive a function

$$y=f(b_0+b_1x_1+\ \dots\ +b_nx_n), \qquad (1)$$

relating x_1, ..., x_n explanatory variables to an outcome y, minimising some error measure, where b_0, b_1, ..., b_n are the fitted coefficients and the operator f denotes the functional form. The multilayer perceptron differs from such statistical approaches only in the procedures used to obtain the functional form. Specifically:

- The MLP does not rely on distributional and other statistical assumptions in deriving model coefficients, but searches heuristically for the coefficient set that minimises total error.
- Also, instead of fitting the desired relationship by means of one, unique, linear or logistic function, MLP fits several intermediate models. As depicted in Figure 1, a given model may contain, for example, three generalised linear functions whose predicted values are fed into two other functions, which then provide the overall output value.

The latter characteristic is what distinguishes MLP from more conventional methodologies. No other modelling approach fits a relationship between dependent and independent variables by building intermediate functions and optimising the overall fit. This is an important development in model building. The heuristic providing such global optimisation is known as 'back-propagation of errors' (Rumelhart et al., 1986) and is a generalisation of the well-known hill-climbing heuristic for iterative unconstrained optimisation.

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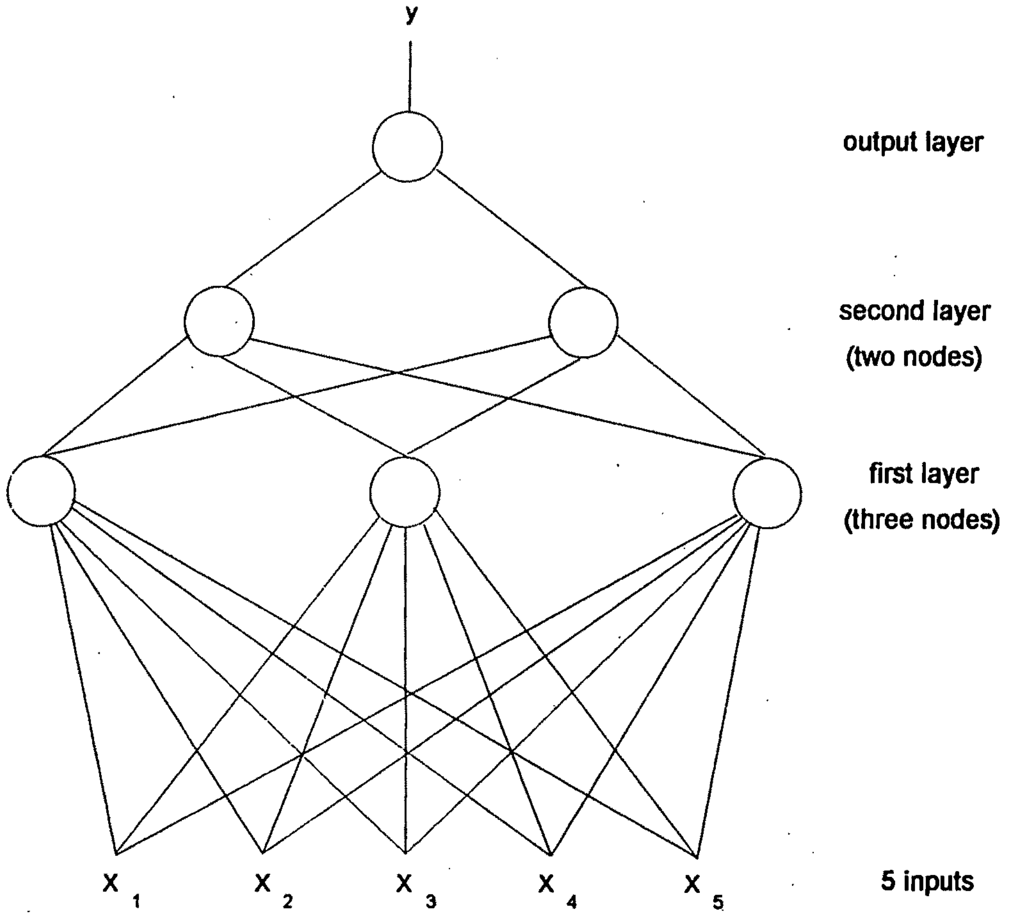
[3] Some of the principles underlying the MLP apply equally to other connectionist tools. Trigueiros (1994) provides an introduction to the self-organised map (Kohonen, 1984) and illustrates with an accounting application. Kryzanowski and Galler (1995) use Boltzmann machines in the analysis of small business financial statements.

Figure 1
A Neural Network – Each Node Represents a Separate Generalised Linear Function



Neural network texts use the languages variously of telecommunications, neuro-biology and computer science. In the specialised literature, for example, explanatory variables are referred to as 'inputs' while values predicted by the model are known as 'outputs'. It is also usual to call the observations 'input patterns' or simply 'patterns'. Also, a given network will be characterised by 'nodes' forming 'layers' where, broadly speaking, each node is similar, typically, to an individual logistic regression.[4,5] The coefficients of these regressions are variously known as 'weights', 'connections', 'synaptic links' or a mixture of these. The appendix provides a glossary of relevant terms.

Other characteristics of neural network methodology are also relevant to accounting researchers; some are beneficial, some are limitations:

- a key strength of the MLP is its ability explicitly to handle variable interactions and other forms of non-linearity;
- since a neural network with enough nodes can approximate whatever functional form best fits the sample data (see Hill et al., 1994, p. 6), generalisation needs to be treated with care because of the tendency towards overfitting. Rigorous out-of-sample testing of any such model is thus even more important than with conventional statistical approaches;[6]
- building a neural network requires considerable computer power and skill in guiding the algorithm;

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[4] Most neural network applications use sigmoidal, such as logistic or hyperbolic tangent, or similar smooth threshold functions to obtain the required non-linear formulation (the *f* in equation 1). The logistic formulation is given by $y=\frac{1}{1+e^{-x}}$ and the hyperbolic tangent by $y=\frac{e^{x}-e^{-x}}{e^{x}+e^{-x}}$ where $X=\sum b_i x_i$.

[5] Figure 1 illustrates a network with five inputs and three layers of 3, 2 and 1 nodes respectively.

[6] A rule-of-thumb generally used for avoiding overfitting is to restrict the number of coefficients to a maximum of 10% of the number of cases.

- neural network methodologies do not yet provide adequate significance and hypothesis tests;[7]
- neural networks are difficult, if not impossible, to interpret or explain conceptually.

Some of these require further elaboration.

3.1 Heuristic Search

Neural networks begin searching for minimum error by setting their coefficients or weights to random values. An observation is then sampled randomly without replacement from the data set and each coefficient in the network is modified by an arbitrary small value to reduce the error between the expected value and the actual value (the output of the network).[8] This is termed a 'presentation'. Next, another observation is randomly sampled from the remaining data set and the same procedure is repeated with regard to this second case, treated independently of the first. This process continues until the entire set of observations is exhausted. The whole set of presentations is then repeated. After a large number of these cycles, the network coefficients, initially random values, tend asymptotically towards describing the underlying relationship. Such an iterative procedure eventually leads to minimum error in some pre-defined sense, thus, in effect, yielding results similar to traditional statistical tools. In connectionist terminology, this optimisation process is termed 'learning' or 'training'.[9]

Heuristic search procedures make MLP less dependent for error minimisation on certain underlying statistical assumptions about a data set. Nonetheless, MLP suffers from exactly the same problems arising from influential or extreme cases as traditional statistical methods; this is often not recognised when acknowledging the distribution-free strengths of MLP.

3.2. Non-linearity

The principal benefit of adopting neural network methodology in practice lies in its ability to model complex interactions between independent variables. For example, in a classification type problem, MLP uses more than one boundary for separating groups. Since each node or intermediate function in a neural network is a partial classifier, it contributes one boundary to the overall classification. The final function utilises these boundaries in building a more complex frontier.

An important example is known as the 'exclusive OR' (XOR) classification problem which involves, in its simplest form, two groups of cases, eg., groups A and B, and two explanatory variables eg., x_1 and x_2. As illustrated in Figure 2, when both x_1 and x_2 are either large or small the group is B. When the same variables go in opposite directions, then the group is A.[10]

Whereas, in theory, only two independent variables should be sufficient to separate the two groups A and B, conventional classifiers such as linear or quadratic discriminant analysis are ineffective since a single boundary, either linear or non-linear, is inadequate.

The XOR classification problem is of paramount importance in pattern recognition applications, and the success of MLP here stems from its ability to solve it. Using MLP in classification task domains where there is no plausible reason to expect XOR interactions will substantially reduce its potential utility when compared with conventional statistical methodologies.

Another, although less important, benefit is the ability of a neural network to deal with piece-wise non-linear relationships explicitly and thus perform better than conventional polynomial models out of sample range (Hill et al., 1994, p. 6).

3.3. Statistical Considerations

Issues important in statistical modelling, such as sampling, and significance and hypothesis testing, are less relevant in pattern recognition. Consequently, statistical tests have yet to be developed beyond a rudimentary level in connectionist methodology:

> '...since the ANN [artificial neural network] model form is non-linear in the model coefficients, the normal probability model is not applicable. Consequently, ANNs do not have parametric statistical properties (eg., they do not have individual coefficient or model significance tests based on the *t* or F distributions)' (Gorr et al., 1994, p. 19).

The concern is that, as such significance tests are developed, some of the benefits of the neural network approach (eg., distribution-free optimisation) might become less evident.

3.4. Building and Interpreting Models

The building of MLP models is difficult to carry out, and the resulting models and their outputs are

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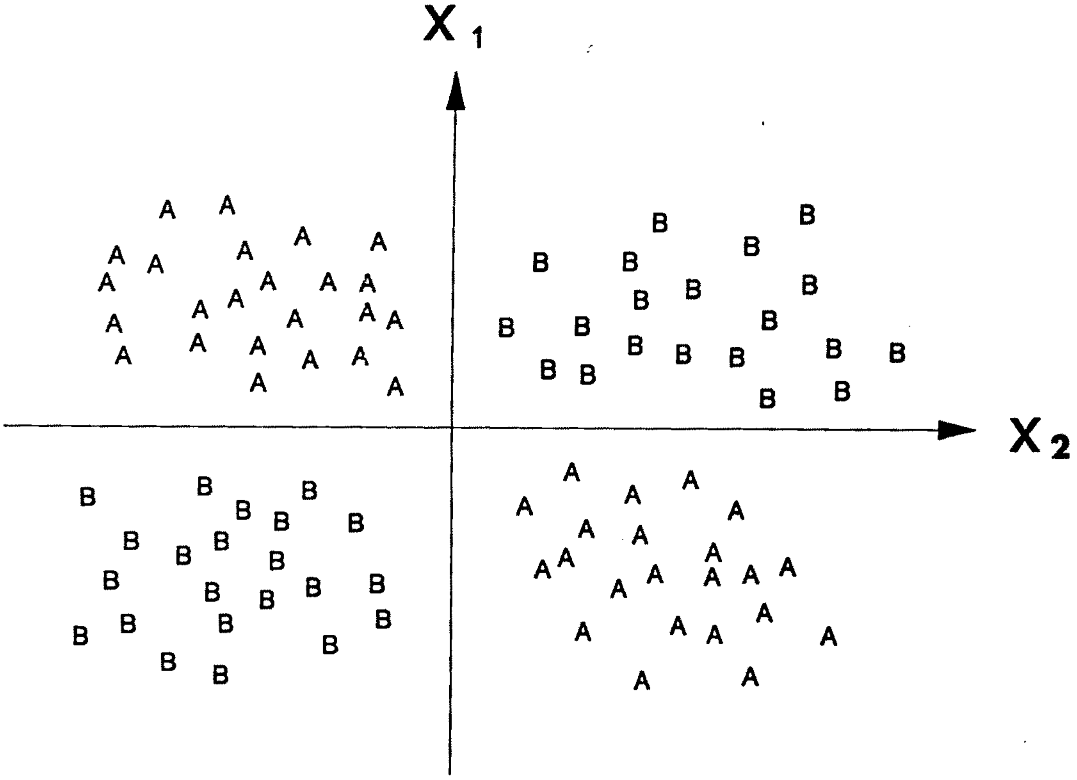
[7] Although this is a serious problem for the social scientist, it is not necessarily a major drawback in the experimental sciences.

[8] It is this updating of weights that is known as back-propagation.

[9] The technique described in this paragraph is the most widely used, but by no means the only one available. It is termed 'stochastic learning' in contrast to 'batch learning', where coefficient updating is carried out only at the end of each cycle. See Azoff (1994, ch. 4) for a non-technical description of learning procedures used in the forecasting of time-series.

[10] The same problem can be generalised to multivariate, multi-group situations.

Figure 2
The XOR Classification Problem



seldom directly interpretable.[11] MLP training requires extensive computing power, especially when the number of observations is large, and direct intervention by the model builder, which, to be effective, presupposes practice and experience.

The appropriate number of layers and nodes is often application-specific and, in practice, needs to be determined on a trial and error basis. There are also many rules-of-thumb, often picked up by experience, which are important for avoiding such problems as false minima or oscillations during training, for speeding up the iterative search for a global solution, and for obtaining parsimonious models through coefficient (weight) or node pruning.[12]

Once a neural network model is developed, only rudimentary methods can be applied to assist in model interpretation (see, for example, Sen et al., 1995, p. 337); however, in general, '...insights from the behaviour of individual model components explaining estimates or forecasts are difficult to obtain' (Gorr, 1994, p. 2).

Whereas neural network models are frequently criticised for their opacity, lack of interpretability should be seen in the light of the complexity of the problem. If the modelled relationship is itself complex, then there is no reason to believe that the fitted model will be transparent. However, the question remains as to whether MLP is too powerful an instrument when used for modelling the relatively simple relationships conventionally found in accounting.

> '...where relatively few explanatory measures are available for making predictions, simple models are often the best, and perhaps no amount of sophisticated methodology will make any improvement....Thus, in cases where there is no underlying structure in the available data, ANN is simply not going to perform any better than the simpler models' (Gorr et al., 1994, p. 19).

4. An application: predicting financial distress

The most widespread application of neural network methodology in the accounting domain to date has been in bankruptcy prediction models, with more than 25 such papers published at the

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[11] Azoff (1994, ch. 4), Baestaens et al. (1994, ch. 1) and Refenes (1995, chs. 2, 3) provide a good survey of current knowledge on network building procedures.

[12] For example, as false or *local* optima may be picked up during network learning, it is advisable to repeat training with different sets of randomly determined initial coefficient values.

Table 2
Summary of the Characteristics of Representative Failure Prediction Models using Neural Networks

Paper	*Task*	*Selection of variables*	*Number of coefficients*	*Sample selection*	*Number of observations used in fitting model (failed: non-failed)*
Salchenberger, Cinar and Lash (1992)	S & L associations failure	Previous studies	5 × 3	Matched	100 + 100
Tam and Kiang (1992)	Bank bankruptcy	Previous studies	19 × 10	Matched	59 + 59
Sharda and Wilson (1993)	Corporate bankruptcy	Altman (1968)	5 × 10	Matched	65 + 64
Coats and Fant (1993)	Firm financial distress as perceived by auditor reports	Altman (1968)	5 × 8	Matched on a 2 to 1 basis	47 + 94
Rahimian et al. (1993)	Firm failure	Altman (1968)	5 × 5	Matched	38 + 36

time of writing. Such studies usually compare a neural network approach with traditional linear discriminant analysis (LDA) or logit methodologies, and the authors, almost without exception, report an increase in the rate of correct classification of firms, banks or savings and loans associations as failed and non-failed using MLP.

Typical recent studies are Salchenberger et al. (1992), Tam and Kiang (1992), Sharda and Wilson (1993), Coats and Fant (1993) and Rahimian et al. (1993). However, comparisons made between neural network and multivariate statistical methodologies are problematic, and inadequate attention is paid to the extant literature.[13] In each case, disproportionate effort is expended in fitting the MLP technique compared with applying the comparative statistical technique (Chatfield, 1993). Classification results, independent of methodology, are uniformly poorer than those reported in conventional earlier studies, perhaps highlighting the respective authors' lack of understanding of the task domain, which is essential for valid application of any model building methodology.[14]

Table 2 summarises the characteristics of these five studies. Only in the case of Salchenberger et al. (1992) are the number of coefficients fitted (15) less than 10% of the observations (see footnote 6 *supra*). The most extreme case is Tam and Kiang (1992), who use 19 highly collinear input variables with 10 nodes (190 coefficients fitted) and only 118 cases in model fitting! Numbers of coefficients derived compare with only four or five in the case of conventional LDA Z-Score models (eg., Altman, 1968; Taffler, 1983).

In comparison, a carefully undertaken large sample study such as that by Altman et al. (1994), which also is a real world application not a methodological 'test-bed', finds little or no difference in classification performance between neural networks and conventional multivariate statistical techniques.[15]

Their best neural network, which has nine inputs and, significantly, only five intermediate functions or nodes (45 coefficients estimated from a data set of 800 firms) performs no better than their equivalent 11 variable linear discriminant model in classifying the held-out cases.[16]

Altman et al. point to the long processing time required to fit neural network models, and the arduous trial and error process required to discover the best model structure, as well as stressing the trap of overfitting. In addition, derived weights are not readily interpretable as with discriminant or logit analysis. They also mention the problems for the financial analyst posed by illogical network behaviour.[17]

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[13] For example, Rahimian et al. (1993, p. 161) dismiss traditional statistical procedures thus: '...hence the predictions of discriminant analysis or dummy regression analysis should be taken with a grain of salt.'

[14] In addition, in all the five papers, samples are selected on a matched basis leading to the likelihood of bias in any holdout tests, and variable selection tends to be arbitrary.

[15] A parallel study, equally relevant from a methodological vantage point although in a different task domain, is Gorr et al. (1994), who develop comparative models for the prediction of student grade point average.

[16] Type I errors of 10.9% and only 4.9% and Type II errors of 6.4% and 9.7% respectively.

[17] Changes in the output variable are not monotonically related to small perturbations in input variables considered one at a time. This phenomenon is consistent with the existence of a degree of overfitting and sample bias in their derived model.

5. Discussion

What contribution can neural network methodology make to accounting research and add to our understanding of accounting issues?

Neural networks are not a substitute for an understanding of the task environment and may best be applied in complex situations where there is no theory to assist the model builder (Gorr, 1994, p. 3). Such tools are only ever likely to dominate conventional statistical models when strong non-linearities, and, most importantly, interactions between independent variables, are present. Other criteria for effective model development, such as the assumption of stationarity, absence of multicollinearity and influential cases and, in particular, model parsimony, equally apply.

5.1. Methodological Issues

Empirical research in accounting typically takes the following form (Tomkins and Groves, 1983, p. 362):

i) Theories are formulated in terms of the relationships between categories, and based on a review of the existing academic literature.
ii) The theory is used to establish a research problem.
iii) The problem is resolved into hypotheses, and dependent and independent variables identified.
iv) Precise and highly-structured predetermined procedures for data collection are established. The data collected are usually in quantitative form.
v) The data are subjected to mathematical or statistical analysis, leading to an almost exclusively quantitative validation of the hypotheses being tested.

In scientific method, apparent performance of a developed model is not the sole objective of the research process. The goal is a better understanding of the underlying accounting issues of concern to the researcher (Chua, 1986, p. 608). The analytical tool used is not of intrinsic interest itself but only a means for elucidating the underlying phenomena.

Moreover, the Popperian doctrine of falsifiability (see, for example, Chua, 1986, p. 607) requires the ability to replicate experimental findings. Because of their strictly heuristic nature, and the extensive requirement for model-builder interaction with the optimising algorithm, neural network results are difficult to replicate, even on the same data set. The opacity of the fitted models can often also add to the problem of understanding underlying relationships.

5.2. Potential Useful Contributions

There may, nonetheless, be cases where neural network methodology can contribute to the accounting researcher's work, when validly applied: for instance, where non-linearity, in particular interactions of an XOR nature,[18] is an underlying facet of the relationship being modelled and, most importantly, where large samples are available to allow its manifestation. The takeover literature illustrates the potential for XOR interactions. The poor results of, for example, Palepu (1986) when predicting takeover targets may reflect the attempt to impose a single boundary between groups where two or more are required. If we believe, for instance, that companies are bid targets for combinations of different reasons, then we require a methodology that allows us to model this appropriately.

Drawing on the substantial literature applying connectionist approaches of a pattern recognition nature in financial forecasting, such as real-time market trading and technical analysis (eg., Baestaens, 1994, ch. 5 and Trippi and Turban, 1993, part 5), we may speculate that related methodology could also have potential application in forecasting accounting variable time-series such as cash flows or earnings. This may particularly be so if hidden interactions or non-linearities pertain in the underlying relationship (Tippett, 1990) such as with half-yearly or quarterly data (Hill et al., 1994, p. 8).

Another potentially useful application of neural network methodology could be in predicting stock returns from accounting and stockmarket data where complex relationships exist and theory is not always helpful. Extant studies assume monotonic linear or log-linear relationships between stock returns and firm factors[19] (eg., Ou and Penman, 1989; Chan and Chen, 1991; Fama and French, 1992; Holthausen and Larcker, 1992; and Lakonishok et al., 1994) whereas this is not necessarily so. Potentially complex interactions between predictor variables are either ignored or handled in a very limited manner. In addition, conventional methodologies used to forecast average returns (eg., the assumption of constant β) are not adequate (Ball and Kothari, 1989). The availability of large sample sizes also suggests connectionist methodologies could play a useful role here.

We may also speculate that, in contrast to the conventional habit of using stepwise regressions and principal component analysis to determine the appropriate independent variables for a neural network, the reverse is more logical. Neural network methodology could be useful for prospective analysis where there is no prior theory to guide model formulation prior to forming hypotheses, and structuring more rigorous analytical models.[20] For example, when studying industry homogeneity, Berry and Trigueiros (1993, p.121) use MLP to select a parsimonious set of variables to be used subsequently in their LDA models.

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[18] Such as the existence of nominal explanatory variables.

[19] Such as book/market, size, β, dividend yield, P/E, gearing and other accounting-based measures.

6. Recommendations to authors

Prospective authors interested in applying neural network methodology to accounting problems should concentrate on using these tools to enhance understanding rather than solely for empirical performance comparisons. The issues of contribution to theory and real advances in knowledge are paramount. Specifically:

- Before falling back on connectionist approaches, authors should first ascertain whether poor empirical performance of conventional statistical approaches is due to their inability to deal appropriately with the complexity of the underlying relationships being studied, or rather through lack of key predictors. An equally plausible reason may be that, given the set of independent variables available, there is nothing more that can be explained independent of methodology.
- Authors should go beyond case studies, simply describing, at best, their neural network methodologies and individual results, and provide enough information to permit replication of findings in related situations.
- Before submission, authors must ensure terminology and style are intelligible to the readership of accounting journals. Neural network papers are currently aimed at a different audience, ie, engineers, applied computer scientists or the operational research community.
- Neural networks exemplify the data mining problem. Therefore, when using connectionist modelling or similar powerful tools, authors should carefully guard against overfitting. The precepts of common sense and parsimony underlying good practice in statistical modelling apply also to neural networks.
- An understanding of the salient differences between accounting research and that in the experimental sciences is mandatory when adopting neural network techniques. For example, sampling issues, statistical inference (eg., significance tests) and hypothesis testing, are far less important in pattern recognition tasks.

This paper should not be taken as a criticism of neural network methodology per se, but only the manner in which it has frequently been applied to date. We believe that the principles underlying our comments are applicable, not only to neural networks, but also to any powerful modelling tool. Such novel techniques should not be adopted uncritically by accounting researchers without first fully understanding their potential contributions and dangers.

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[20] In this context, it should be recollected that Glaser and Strauss (1967) strongly argue for the relevance of grounded theory, the generation of theory from data through induction, also to quantitative measures: '...*if quantitative data is handled systematically...the analyst will indeed find rich terrain for discovering and generating theory*' (p. 220, their italics). They also point out that: 'Statistical tests of significance of an association between variables are not necessary when the discovered associations...are used for suggesting hypotheses' (p. 200).

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Appendix

Glossary

Neural network terminology	**Statistical modelling terminology**
Neural network	Model
Synapses, weights, connectivities, etc.	Coefficients of the model
Inputs	Independent variables
Outputs	Dependent variables
Outcome or target	Expected value
Node	Logistic regression
Hidden layer	Intermediate set of logistic regressions
Learning	Coefficient estimation
Supervised learning	Regression, discriminant analysis, etc.
Unsupervised learning	Principal components and cluster analyses
Architecture	Model description (eg., number of nodes and layers)
Convergence	In-sample performance
Generalisation	Out-of-sample performance

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Book Reviews

European Financial Reporting. A History. *Peter Walton (ed.).* Academic Press, 1995. xii + 287pp. £43.

In striking contrast to the position only two decades or so ago, English language material on financial reporting in the various continental European countries is now relatively abundant. Most of it, however, lacks a historical dimension, so that students of comparative international accounting often find it difficult to understand why, for example, British and French accounting should have developed in such different ways from each other. Researching these historical differences is not easy. As the bibliographies to the chapters in this book clearly demonstrate, much of the material is relatively inaccessible and available only in the language of the country concerned. Furthermore, the history of financial reporting has not yet been researched in detail even by most countries' native scholars.

Thus Peter Walton's book is inevitably only a brave first attempt to throw light on darkness. It covers 13 European countries: the EU countries with the exception of Greece, Ireland, Luxembourg and Portugal; plus Norway and Switzerland. There is an introductory chapter by the editor and a chapter on accounting in the industrialisation of western Europe by the economic historian James Foreman-Peck. The country chapters (with the one exception of Italy) are written by local nationals. They vary in length from 12 pages (Belgium) to 34 pages (Germany).

The editor, perhaps making a virtue out of a necessity, has not attempted to impose a uniform framework on the country chapters, for fear, he states, of imposing a possibly irrelevant Anglo-Saxon perspective. In spite of this, some sort of pattern does emerge. In the chapter on France, Mikol discusses briefly how the history of accounting in that country could be presented, and deliberately chooses to write 'a history of accounting regulation imposed by the state or parliament' (p. 92). This is a procedure followed explicitly or implicitly in many chapters, perhaps because, in the absence of prior research, it is easier, although perhaps misleading, to write accounting history in terms of regulations rather than practices. Where this prior research does exist (as it does, for example, in the Netherlands) the authors make good use of it.

The chapters reveal a complicated set of intercountry influences: for example, of German legislation on Austria (p. 29); of the French Commercial Code of 1807 on Belgium (p. 43), Italy (p. 161), and the Netherlands (p. 170); of German accounting on pre-Second World War Denmark (p. 55); of German standardised accounting on the birth of the French national accounting plan (p. 108); and of Savary's commentary on the French *ordonnance de commerce* (1673) on the German-speaking countries (p. 125). More recently, all European countries (not just member states) have been influenced by the EU directives, and larger companies have been influenced by US GAAP and by international accounting standards.

Despite these influences, the overwhelming impression given in the book is still one of diversity and an insistence on national differences. Napier rightly reminds us that British accounting has evolved in a 'rather idiosyncratic way' (p. 259), but this is true of all the 13 countries in the book. These idiosyncracies have not been swept away by harmonisation. As the editor points out in his introduction, harmonisation through the Fourth Directive 'is a case study in some ways of creating disharmony through harmonisation' (p. 7).

Inevitably a book such as this, with many authors writing in their second language, or being presented to the reader in translation, is not very readable. As a compensation there are passages that strikingly remind the British or American reader of other ways of looking at the world. For example, in the chapter on France, Mikol mentions in passing that the Vietnam war ended in 1954 (p. 93) and later, with tongue in cheek, that 'the principal fault of the 1982 Plan [Comptable] is to have been issued in French: its second fault is not to have been translated into English' (pp. 116–7). Schneider argues that the Anglo-Saxon literature 'has been years behind' the German literature (p. 142).

Those of us who have attempted to edit a book such as this will be well aware of the amount of hard work involved. Teachers and researchers in international accounting will be the beneficiaries. Peter Walton's book should prove especially valuable as a starting point for future research. It deserved a more detailed index.

University of Exeter R.H. Parker

Australian Company Financial Reporting 1995. *J.B. Ryan and C.T. Heazlewood* (eds.). Australian Accounting Research Foundation, 1995. xxiv + 338pp. A$40.

This indispensable survey of Australian company financial reporting practices, comparable to *Accounting Trends and Techniques* in the US and to *Financial Reporting: A Survey of United Kingdom Reporting Practice* by Skerratt and Tonkin, is the fifth in a series by the Australian Accounting Research Foundation since 1975. The editors have been associated with every issue in the series, but in the current edition have enlisted the assistance of numerous contributors, mainly from Charles Sturt, Western Sydney and Wollongong Universities, to prepare the enormous amount of detailed survey findings.

The 1995 edition surveys the top 150 listed Australian companies by market capitalisation, excluding banks and insurance companies, and covers the four-year period ending 30 June 1994, overlapping slightly with the years covered by the 1993 edition.

The book is divided into three parts. Part 1 describes the survey methodology, aggregate statistics for the sample, information on social reporting, highlights and a discussion of the Australian accounting standard-setting process. In part 2, compliance by the 150 companies with each operative AASB standard from AASB 1001 to AASB 1029 is analysed in turn, a separate chapter being devoted to each standard. Part 3 examines other areas of practice not dealt with by AASB standards but covered by the corporations law, professional or overseas standards. In Australia, the AASB standards, which have statutory backing, cover many but not all accounting issues: others are dealt with in the corporations law, and in AAS standards issued by the accounting profession. There is considerable, but not complete, overlap between AASB and AAS standards. Part 3 is particularly interesting as it covers issues such as investments, identifiable intangible assets and contingencies, on which there are international but no Australian standards.

While each accounting issue is treated by a different contributor, the editors have imposed a uniform mode of presentation. Typically, each chapter shows, at a minimum, the number of sample companies disclosing versus not disclosing the item, accounting policies or classifications adopted, illustrations from some of the surveyed companies, and a comment by the contributor. Further, often extensive, details are provided, which vary across accounting issues. Tables are clear and easy to understand. That, plus the excellent table of contents, makes finding those items you want to illustrate your lecture quite easy. Non-Australian readers will find the comparisons between Australian and overseas standards useful.

A few criticisms can be made. The chapter on social reporting in part 1 could have appeared in part 3. While the accounting issues covered by the book are very comprehensive and give the reader an excellent idea of the standard of financial reporting in the top 150 companies, Australian exposure drafts on issue during the survey period, such as ED 59 on financial instruments, are not covered. There is no index. However, these are minor quibbles.

Without doubt, the book is a valuable research and teaching resource, and Australian accountants are very much in the editors' and contributors' debt for all their efforts. Please keep up the good work!

University of New South Wales — Richard D. Morris

An Accounting Thesaurus: 500 Years of Accounting. *R. J. Chambers.* Pergammon Press, 1995. xxi + 1,011 pages. £55/$88.

Professor Chambers has given us a useful work in unexpected form. His book is a vast collection of quotations on all aspects of financial accounting. He tells us that it is not an encyclopedia; and perhaps it is best regarded as a filing cabinet full of apt and well-ordered quotations ('the dicta of the past') from the works of innumerable writers.

The book is thus evidence of the authors' enviable range of reading. It has over 1,000 pages, and some 7,000 quotations. It weighs nearly 5 kilos. (Unsuitable for reading in bed.)

It is arranged in 10 major sections—on the economic background, asset valuation, income, and so on. Each section is split into chapters. Thus the income section has chapters on concepts, matching, inventory charges, etc. And under each of these headings are several sub-headings (income as gain, income or profit as increase in wealth, varied interpretations of capital maintenance, etc., etc.). And then each sub-heading is followed by perhaps nine or 10 quotations, telling us what various writers have said on the topic.

So a reader seeking pertinent quotations has little trouble in finding them. His task is made easier by a lengthy subject index and a source index (though I suspect that some of their page numbers have slipped a bit).

The book shows (among other things) that there is healthy disagreement among accountants on some important topics. Take realisation.

> 'The accountant assumes...that expense accrues but that net revenue or...profit suddenly appears, full blown, on some specific occasion, commonly that of the sale' (Paton).
>
> 'Gain or loss is realised only through sale' (Gordon and Shillinglaw).

But then come:

> 'Is not the postulate of realisation based on a fallacious theory of exactness?' (Knauth).
>
> 'One of the most obvious and important of economic truths is the fact that a profit is an increase in net wealth...The notion that the validity of a profit depends upon its being realised is childish, untrue, and in complete opposition to the realities of modern business procedure' (Macneal).

And note the clash over matching:

> 'We can never complete a structure of accepted principles of accounting without basing such principles upon a logical, consistent convention of matching costs and revenues' (Gilman).
>
> 'Perhaps the greatest advance ever made in explaining accounting theory is the concept that the preparation of a profit and loss account is a process of matching cost with income' (Fitzgerald).

But then come:

> 'matching is an inadequate indication of what is actually done...what transactions or acquisition prices shall govern the determination is a matter either of convention or of subjective choice' (AIA).
>
> 'the allocation of costs to accounting periods is based on conventions, some highly arbitrary' (May).

The book shows alas that we accountants are dull dogs: the quotations are lit with few glints of humour, and seldom set the blood racing. The best are by non-accountants. The (somewhat irrelevant?) section on philosophy at least shows that philosophers can write pleasant English. And take Boswell's familiar explanation of the 'net assets' versus 'discounted cash flow' approaches to a firm's value:

> 'When the sale of Thrale's brewery was going forward, Johnson appeared hustling about, with an inkhorn and pen in his buttonhole like an exciseman, and on being asked what he really considered to be the value of the property which was to be disposed of, answered "We are not here to sell a parcel of boilers and vats, but the potentiality of growing rich beyond the dreams of avarice." '

The book has little on management and costing. Perhaps Professor Chambers will now put us further into his debt by giving us a second volume, on these areas.

London School of Economics W.T. Baxter

True and Fair. A History of Price Waterhouse. *Edgar Jones.* Hamish Hamilton, 1995. xix + 444pp. £25.

Edgar Jones made the first academic study of the history of an accounting firm, *Accountancy in the British Economy 1840–1980: The Evolution of Ernst and Whinney*, published in 1981. It set new standards for this type of inquiry by placing the firm's development within a broad economic and social context. The present book is presented as a story of both a professional partnership and commercial enterprise, focusing on the individuals who led and shaped the firm, and on the clients they served. In that sense it is a more traditional history of an accountancy firm.

The author has been provided with substantial back-up both from within the firm, with a History Committee guiding the project in its execution and commenting on various drafts, and from outside, with Professor Barry Supple serving as external assessor. In addition to researching the company's extensive archive, the author has utilised the secondary literature and conducted interviews with leading figures from the accountancy profession, including Lord Benson, Sir Ronald Leach and Roy Chapman. It represents a culmination of four years' work and has been eagerly awaited. Readers will not be disappointed.

Jones traces the history of Price Waterhouse from its earliest origins, when Samuel Lowell Price started out in the City in 1849, through to 1994, when the firm was represented in more than 100 countries and employed over 50,000 people. The book consists of 11 chapters and an epilogue which, due to the lack of historical perspective, 'is cast in the nature of a survey of recent significant events, and [is] one necessarily conducted with less depth and range of research' (p.311). The outcome of this decision is to rule out an in-depth and critical assessment of the role of Price Waterhouse in the 'troubled events' of Guinness and BCCI.

The introduction sets out the three underlying themes, namely: the firm's unique character in terms of continuity; a determination to achieve professional excellence; and progressive internationalisation. These are unsurprising and could probably be equally used as a framework for the study of most major professional practices. And, while it is true that the company has never been subject to a merger with a partnership of equivalent size (though the matter was given consideration in 1921 with Peats, in 1984 with Deloittes, and in 1989 with Andersens), Jones acknowledges that Henry Benson, writing in 1989, similarly believed that 'the basic professional principles which were laid down by the Cooper Brothers in 1854 have remained unchanged' (quoted at p.24).

The first third of the book deals with developments up to the First World War, and the broad thrust of the messages conveyed will be familiar to students of accounting history, although the text does include a great deal of additional detail relating to the particular role of Price Waterhouse. In certain areas, however, Jones provides valuable new insights; for example, in relation to the role played by Dickinson in the development of the American practice following his appointment as resident partner in April 1901.

Dickinson quickly realised that quite different strategies were required to cope with business conditions that side of the Atlantic. Audits were thin on the ground and more difficult to obtain and retain. Having lost an important local audit, Dickinson sought to raise Price Waterhouse's profile by despatching 36,000 announcements of his appointment as senior partner to leading bankers, lawyers and merchants, and also to the financial press. Towards the end of this book, Jones demonstrates the fact that relaxations in professional guidelines in the UK in the 1980s have done little more than to produce a situation similar to that which prevailed in the US at the turn of the century.

A strong theme throughout the book is the fundamental change that took place in the nature of this accounting practice, and possibly others, between about 1965 and 1975. Price Waterhouse in 1965 continued to be run by a small group of partners who met every morning to discuss business. Leading post-war figures such as Sir Thomas Robson and G.E. Richards did not *seek* innovation, and attempted to maintain standards of conduct, technical excellence and professional integrity. Neither saw themselves as businessmen or as men who were running a commercial enterprise for profit. As Jones puts it, 'They were, of course, concerned to generate a healthy surplus but would have seen this as the natural outcome of a well-run practice' (p.211).

Indeed, although massive expansion had taken place over the previous 100 years or so, the essential features of the professional practice initially developed by Price and Waterhouse in the second half of the 19th century remained in place.

From the 1970s, however, fundamental changes identified by Jones include an increasingly commercial attitude, new strategies of recruitment, training and career development, a hierarchy of functional committees and other innovations designed to manage an ever more complex organisation. The construction of Southwark Towers, at London Bridge, is seen to symbolise the fundamental change that was occurring within the firm. As the result of this move, 'The elegant terraced offices of Frederick's Place, which outwardly symbolised tradition, reserve, discretion and probity, had been replaced by a purpose-built, eye-catching tower block described by Pevsner as having "screens of reflecting glass" which "break up the surfaces and give the building a glittering elegance but secretive face". Southwark Towers was an outward expression of the firm's professionalism, stability and ambitious approach to business' (p.273).

One further manifestation of this growing commercialisation has been greater mobility among senior staff, with individuals for almost the first time both coming in at top level and leaving the firm for alternative attractive engagements.

The 1970s saw the rise of what the accountancy press captioned 'the Big Eight', and what Jones describes as 'the quiet revolution'. The appearance of 'the Big Eight' marked a fundamental change in the nature of the profession, with the large organisations wiping out the medium-sized firm and their adopting many of the essential features of what might be called big business. For example, loose worldwide networks were replaced by a single corporate style, and the endeavour to introduce common procedures and technical standards across the board. Moreover, whereas accountancy firms had traditionally looked to their professional bodies for guidance, they now became major business concerns in their own right and 'turned to their own committees and research groups when matters of policy and practice arose' (p.248).

With commercialisation gaining pace, the 1980s is identified as the period when Price Waterhouse's growth, having previously been 'essentially reactive', became proactive. The need to protect the firm's audit portfolio as an important source of new work is emphasised, but the burgeoning MCS department was the main engine of progress. Of particular relevance in this context was the reversal of an earlier key strategic decision *not* to offer advice on production problems, marketing and sales policies or time studies on the grounds that such work, requiring the employment of specialists such as engineers, would 'give rise to fundamental problems for the firm and for the accountancy profession' (quoted on p.234).

From the late 1970s, the expansion of MCS came increasingly from diversification into non-accounting areas. Staff numbers engaged in MCS grew from about 60 in 1975 to 218 in 1982, further rising to 1,140 by 1990. The contribution to total fee income rose from 3.2% in 1976 to 9% in 1982 and 28.8% in 1990. Indeed, MCS grew at around 25% to 30% in real terms every year during the

1980s, raising it to the second largest unit behind that of Coopers and Lybrand. The recruitment of non-accountants blossomed, with just nine qualified accountants among the 32 consultancy partners in London in 1992.

The distinctive nature of MCS is of particular interest in evaluating the changing nature of the large accountancy practice, and is summed up as follows by Jones: 'Auditing requires a continuity of commitment and the establishment of an ongoing relationship, whereas consultancy is about a succession of varied assignments, each won by competitive tender. Change and uncertainty are the watchwords of consultancy' (p.315).

This enthralling study is also anchored by a study of three heroes: Edwin Waterhouse from the 19th century, Gilbert Garnsey during the inter-war period, and Michael Coates, whose 'seminal paper' of June 1973 contained the ideas and proposals that were 'to exercise the firm for the next decade' (p.258). In this context, Jones argues that the impetus for the growth of the accountancy profession provided by company doctors such as Garnsey during the inter-war period was lost in the aftermath of the Second World War to merchant banks, due to the fact that the profession's leaders were preoccupied with technical issues.

Michael Coates is credited with having worked to change Price Waterhouse's image in order to make up this lost ground. The heroes I take from this study, at least for the post-war period, however, are Nicholas Waterhouse, Robson and Ted Parker, whose emphasis on service and tradition are so well brought out by Jones.

Cardiff Business School John Richard Edwards

The Theory and Measurement of Business Income. *E. O. Edwards and P. W. Bell.* Garland Publishing Inc., 1995. xiii + 323 pp. $60.

This is a welcome reprint of Edwards' and Bell's classic treatise, with the additional bonus of a new introduction by the authors.

The new introduction is, unfortunately, only six pages long, and this does not allow space for a full account of the development of the book, which would undoubtedly be of great interest to historians of accounting thought. The authors assert that they 'would not make any substantive revisions' were they to revise the book today, but they do point out three matters of exposition that they would want to improve on: first, the distinction between individual price changes and changes in the general price level; second, the distinction between current income (as in Edwards and Bell) and traditional historical cost income; third, the use of the deprival value rules to explain the choice of alternative current values.

Even within the short compass of the new introduction, there are two issues that require discussion. First, the contribution of Henry Sweeney to clarifying the distinction between accounting for specific price changes and general price changes (in Chapter 3 of his *Stabilized Accounting*) is given inadequate acknowledgement:

> 'General price level adjustments, too, had been set forth in considerable detail in the work of Henry Sweeney. But no general framework for treating these two types of changes separately, but in an integrated fashion had been developed' (p.vii).

Second, (on p.viii) they characterise the British system of current cost accounting (as in SSAP 16) as 'actually adjusted for specific prices and not for inflation'. It is true that the SSAP 16 system did not adjust explicitly for general price changes, but the current cost capital maintenance system, by adjusting for specific prices, can be interpreted as adjusting both for relative price changes (of the assets comprising the entity's capital base) *and* for inflation (reflected in the changing value of the money in which the capital base is measured). Moreover, the SSAP 16 system did make an attempt to capture the effects of inflation on monetary items through the monetary working capital adjustment and the gearing adjustment, albeit that these adjustments are based on specific prices and have contentious theoretical foundations.

Despite these reservations about the new introduction, it is to be hoped that the reprint of the original text will enable a new generation of scholars to gain access to one of the seminal works on accounting theory. It is a tribute to Edwards and Bell that their work is still so widely cited by academics and has had such a visible impact on the work of accounting standard-setters, despite the swing of academic fashion away from 'normative' theory during the past quarter of a century. When the fashion reverses, as it surely must, the confidence of the publishers of this reprint will receive its just reward.

Cambridge University Geoffrey Whittington

A Landmark in Accounting Theory: the Work of Gabriel A. D. Preinreich. *Richard P. Brief.* Garland Publishing Inc., 1996. xxiii + 205 pp.

As a young undergraduate I can well recall Professor Ken Wright's paper 'Towards a General Theory of Depreciation' (*Journal of Accounting Research*, Spring, 1964) appearing on the reading list of the advanced accounting theory course I was taking in my final year. I was attracted to the article because of its disciplined and rigorous approach to an area characterised by discursive and often ill-structured argument. Buried away in the footnotes were references to some of the enduring articles of the area, including papers by Gabriel Preinreich (from the 1938 number of *Econometrica*) and Harold Hotelling (from the 1925 number of *Journal of the American Statistical Association*).

I recall regarding Preinreich's paper as the more impressive of the two, principally because it accommodated a dual approach to the depreciation problem—namely, that based on neoclassical accumulation theory (Pigou, but more latterly the 'supply side' arguments used to justify contemporary asset pricing theories) as well as more popular versions based on Hicksian economic income ideas. The former seems to have been 'lost' to the accounting literature, although it is very much 'alive' in both the contemporary economics literature and in Preinreich's papers. Hence, for this and other reasons, Professor Brief does our discipline a great service when he prepares an anthology based on the published works of one of the unsung giants of our discipline, Gabriel A. D. Preinreich.

The book starts with a fascinating account of Preinreich's life. He was born in Hungary in 1893 and passed away at the relatively young age of 57. His academic training included the Austro-Hungarian Naval Academy, where he graduated as an ensign; the City College of New York, where he received the BS and MBA degrees, and Columbia University from whence he took the PhD degree. He published three books and over 20 articles, but despite this, his academic contemporaries appeared to regard him as an 'outsider'.

Two possible reasons are suggested: first, for most of his working life he was a sole practitioner and not a member of the academic community, and, second, he had a rather cutting pen. Thus he berates C.F. Roos (who was a Fellow of the Econometric Society) for some 'curiously futile' work in the depreciation area, and he concludes an unsolicited book review of Edwin B. Kurtz' *Science of Valuation and Depreciation* with the caustic remark that 'the new book does not measure up ... to its sanguine preface ...' I suspect we have all had similar thoughts about published works, but few of us would be confident enough to take them into print!

Professor Brief applies two criteria in selecting papers to be included in this volume. First, only those papers related to the nature of dividend yields, valuation, goodwill and depreciation were selected. Second, articles that seemed mainly of interest to mathematical economists were not reprinted. This latter requirement is unfortunate because it meant what many consider to be Preinreich's most accomplished work, 'Annual Survey of Economic Theory: The Theory of Depreciation' (from the 1938 number of *Econometrica*) is not included in the present volume. Professor Brief is quick to note, however, that this paper was included in a previous edited collection, *Depreciation and Capital Maintenance* (Garland), published in 1986. This means that the book is divided into three sections; namely, Accounting from the Investor's Viewpoint (which contains three papers), Goodwill and Valuation (which contains four papers) and the Depreciation Problem (containing three papers and two book reviews).

The papers included in the first section include 'Accounting Problems of the Unincorporated Investment Trust', originally published in 1931, which reflects Preinreich's initial interest in the question of how to account from the investor's viewpoint. It was also the basic framework for Preinreich's PhD thesis at Columbia. A second paper, entitled 'Stock Yields, Stock Dividends and Inflation', published in 1932, is a masterly and still contemporary piece of work. Here Preinreich develops 'the laws of the yield to serve as a trend line or axis marking the theoretical position of the equilibrium around which the actual oscillations of market values must, in the long run, be evenly distributed'.

The final article in this section, 'Fair Value Yield of Common Stock' continues the theme of the 1932 paper, but here we find Modigliani and Miller dividend irrelevance some 20 years ahead of its time. For Preinreich writes: 'The yield of common stocks is not dependent upon the corporate dividend policy so long as that policy conforms to the principal of good management.'

The first article of the second section is entitled: 'The Law of Goodwill', published in 1936, which deals primarily with the history of the subject up to that time. The second article, 'The Valuation of Goodwill', published in 1937, links court-approved methods of valuing goodwill to excess earnings. The third article, 'Valuation and Amortisation', also published in 1937, links goodwill and depreciation to figures contained in balance sheets. These papers are the embryonic form of some later work carried out by Harold Edey, Edgar Edwards and Philip Bell, and more latterly, the 'clean surplus'-based ideas of Ken Peasnell and James Ohlson. The final paper in this section, 'Economic Theories of Goodwill', published in 1939, addresses the question of goodwill and valuation primarily along Marshallian lines and not, as one might have anticipated given Preinreich's quirk for anticipating future developments, along the Arrow-Debreu lines that were to emerge some 30 years later.

The final four papers deal with varying aspects of depreciation. The first, 'The Principles of Public-Utility Depreciation', published in 1938, reports favourably on Perry Mason's American Accounting Association monograph, 'Principles of Utility Depreciation', published the year before. He notes, however, that Professor Mason carries the discursive method about as far as it can be taken in this area, and concludes that 'No justice can possibly be done to this subject without the extensive use of mathematics ...' The second paper, entitled 'The Practices of Depreciation', constitutes an attempt to put into practice some of the theory developed in his 1938 *Econometrica* survey paper. The final paper, 'Note on the Theory of Depreciation', constitutes a response to some criticisms made of the 1938 paper. Two book reviews round out this section.

For the reviewer, however, the most intriguing thing about this section is the clever way in which Preinreich anticipates the neoclassical theory of capital accumulation (and hence all modern asset pricing theory), and integrates it with valuation concepts later developed by Sir John Hicks. Much contemporary literature casts the two approaches as uncongenial twins, but Preinreich clearly saw that this was not the case. Unfortunately, one cannot 'see' Preinreich's thinking clearly from the articles reproduced in the present volume. His 1938 *Econometrica* Survey article (notably pp. 219–233) would have to be read first.

This is a delightful collection of readings, and Professor Brief has done our discipline a great service in overseeing its publication.

University of Wales
Aberystwyth
Mark Tippett

Leonard M. Savoie: Words from the Past, Thoughts for Today. *Donald E. Tidrick (ed.).* Garland Publishing, Inc., New York and London, 1995. xix + 262 pp. $55.

Leonard Mitchell Savoie (1923–1991) is not known outside the US, and is probably little known by American accountants under the age of 50. He deserves to be remembered because of the vital role he played as the full-time executive vice-president of the American Institute of Certified Public Accountants from 1967 to 1972, during a critical period in the life of the AICPA's Accounting Principles Board (APB). This volume is a collection of 18 of his speeches and his eight reports to the AICPA Council, compiled and edited by an admiring colleague.

Len Savoie was an honours graduate of the University of Illinois at Urbana-Champaign. He joined Price Waterhouse & Co and eventually became partner in charge of the firm's research and professional development. He was the chief architect of the firm's expanded professional development programme, and in 1962–63, he took a year's leave as Sir Arthur Lowes Dickinson Fellow at the Harvard Business School to study the case method of instruction and develop case materials for the firm's programme.

In 1967, Savoie left Price Waterhouse to become the AICPA's newly-created executive vice-president at a time when the APB was under fire in the press and from a rising chorus of critics. His announced assignment was to be the Institute's leading spokesman on accounting and auditing, but, in the main, he was to serve as a forceful liaison between the APB and the outside world. It was an inspired choice. Savoie had a driving intellect and an incisive mind, and he was a man of principle and devotion to his profession. It was the APB's most productive period, and he played a key role in supporting its work.

Savoie chose to leave the AICPA in 1972, shortly before the Institute's Council accepted the recommendation of the Wheat Study that the work of the APB be transferred to an independent body, the Financial Accounting Standards Board (FASB). For the next seven years, he was vice-president and corporate controller of Clark Equipment Company, a multinational whose head office was in south-western Michigan. From 1980 until his death, he was professor of accounting at the University of Notre Dame, and for seven years served as chairman of the accounting department. The editor of this collection was a junior member of the department during the final four years of this period.

Of the 26 papers included in the collection, all written between 1967 and 1982, Savoie's semi-annual reports to the Institute's Council hold the greatest interest. It is there that one finds ample evidence of his commitment to high professional standards. In his two reports rendered in 1968, he complained that auditors were compromising their standards, ingratiating themselves with company managements, and behaving as if their calling were more a business than a profession. He said that 'there is evidence that CPAs sometimes argue on behalf of a client for an accounting treatment that appears to be prohibited by an APB Opinion' (p. 18).

He warned Council that 'if we don't discipline ourselves, someone else will do it, and we shall lose professional status' (p. 22). (As suggested by the subtitle to this book, these criticisms continue to have force today.) It was a time when the courts and the financial press were lecturing the profession on the auditor's role and responsibility to investors, and he believed that the profession was not listening.

The other 18 papers cover education, ethics and independence, and standard-setting. The four papers on education are unremarkable: he was one of the early advocates of professional schools of accounting. In the four papers on ethics and independence, he issued admonitions against auditors serving management and not the owners, and against 'promotional salesmanship' (p. 104). 'Competition for a client based on accounting principles', he said, 'must be stopped' (p. 112).

In several of the 10 papers on accounting standard-setting (as in his reports to Council), Savoie draws attention to 'economic consequences' issues that were facing the APB and the FASB, thus reminding us of the gathering pressures on standard-setters during the late 1960s and the 1970s. In the 1970s, numerous releases issued by a hyper-active Securities and Exchange Commission led him to believe that standard-setting, notwithstanding the SEC's protestations, was moving inexorably toward the public sector. In the final paper, he is strongly critical of recent policies and actions of the SEC (pp. 227–40).

Savoie writes as a keen observer and critic of professional and regulatory developments. He does not spin theories or propose grandiose solutions.

It is unfortunate that the editor limited the collection to only previously unpublished papers. Some of Savoie's better papers were published, and a few of these (especially his 1963 article, 'Accounting Improvements—How Fast, How Far?' in the *Harvard Business Review*) arguably should have been included. But the editor has thoughtfully provided a complete bibliography of Savoie's published and unpublished writings, so interested readers can explore further.

Rice University Stephen A. Zeff

Accounting Research 1948–1958, Volume 1. Selected Articles on Accounting History. *David Solomons and Stephen A. Zeff.* Garland Publishing, 1996. xxx + 253pp. $58.

About 10% of the articles published in *Accounting Research* (1948–58), the predecessor journal of *Accounting and Business Research*, sponsored by the Society of Incorporated Accountants, were devoted to accounting history. All of them are reprinted in the present volume. Many, but not all, are still well worth reading.

Inevitably the best have already been reprinted elsewhere, e.g. Robert's 'A Short History of Tallies', Gordon's 'The First English Books on Bookkeeping' and Coomber's 'Hugh Oldcastle and John Mellis' in Littleton and Yamey, *Studies in the History of Accounting* (1956); Burley's 'Some Accounting Records of an Eighteenth-Century Clothier', in Yamey, *The Historical Development of Accounting* (1978); Yamey's 'Handson's *Analysis of Merchants Accompts*—An Unrecorded Broadside' and 'John Weddington's *A Breffe Instruction*, 1567' in his *Essays on the History of Accounting* (1978); and Hill's 'Accountancy Developments in a Public Utility Company in the Nineteenth-Century' in Lee and Parker, *The Evolution of Corporate Financial Reporting* (1979).

Moreover, Thomson and Yamey's 'Bibliography of Bookkeeping and Accounts—1494 to 1650' has been replaced by two bibliographies, one on books on accounting in English 1543–1800, the other on books on accounting in other languages 1494–1750, both of which are reprinted in Parker, *Bibliographies for Accounting Historians* (1980). Not all the articles were worth reprinting. The reviewer would have omitted the papers on 'A French Emigré Officer's Accounts' and 'Speculations on Roman Influence on the Theory of Double Entry Bookkeeping'.

The study of the earliest (mid-16th century) English language texts on double entry has ceased to be fashionable, but I much enjoyed reading again the papers and communications in this volume dealing with the discovery of 'lost' works. Coomber describes how he successfully tracked down a copy of the English translation (1547) of Ympyn's *Nouvelle Instruction*, which had survived the Second World War in the Soviet Union. Coomber, alas, was not able in his paper on Oldcastle and Mellis to report the discovery of a copy of Oldcastle's *Profitable Treatyce* of 1543. Such a discovery may still take place, since a copy of Weddington's *A Breffe Instruction* (1567), the subject of a paper by Yamey, 'came to light' in the Library of Blairs College, Aberdeen in 1957.

The editors are rightly critical of the 'chilly and grudging' attitude of the Institute of Chartered Accountants in England and Wales which was responsible for the untimely demise of *Accounting Research*, but are themselves rather grudging in their comments on its editors, Sewell Bray and Leo Little, who surely deserve to be congratulated on producing such a journal with such a prestigious publisher (Cambridge University Press) when *The Accounting Review* was the only other academic accounting journal in the world. The editors fail to mention the founding of *Accounting and Business Research* by the Institute in 1970. Despite this, and so as not to appear grudging myself, this volume, and its companion on accounting theory, are greatly to be welcomed.

University of Exeter R.H. Parker

Research Methods in Management Accounting. *Peter Brownell.* Coopers & Lybrand/AAANZ, Australia, 1995.

This is an excellent book, which should be required reading for every doctoral student in management accounting, and for many of their supervisors as well. In the short compass of only 78 pages, it covers the basic foundations of the research methods necessary to conduct a well-constructed piece of empirical research in this field, and indeed in other areas of accounting and finance as well. I know of no other reference that covers the material as cogently, and in such a readable manner, as this little monograph; it contrasts well with texts of 10 times its length aimed at social sciences students.

Its strength is that it is written by an eminent practitioner of the use of empirical methods in management accounting, and draws extensively on his own comprehensive theoretical training and subsequent practical experience. Within its chosen limits, it draws out and explains the essential ideas in a succinct and understandable style, giving many practical examples of their application in practice.

Brownell is very clear about these limits. The book is about empirical research methods, not methodology; scholarship drawing solely on library sources is not considered, neither is pure critical work. The reason is both practical (the author lacks experience in these fields) and ideological (he strongly believes students should be directed towards positive, empirical work at the start of their training). It is also noted that accounting researchers are essentially parasitic in their use of research methods, drawing selectively on those that have been developed in other disciplines (notably psychology, sociology, anthropology and politics).

There are three main chapters covering experiments, survey research and case study methods. The experimental chapter is probably the best, drawing on the author's training in psychology. It covers both true and quasi-experiments, and focuses on the key concepts of internal validity, construct validity, external validity and reliability. It considers the main threats that exist to attaining these ideals, and discusses practical methods for limiting the problems that arise if carefully specified conditions are not met.

It concludes by examining the opportunities that can arise to conduct field experiments, so that external reliability might be improved. My only criticism is that little time is spent on the issue of how experiments are developed and refined; my own experience suggests that many experiments demonstrate the ingenuity of the experimenter in constructing a situation in which subjects behave as they are expected to, rather than necessarily illuminating a phenomenon that is readily observable in the real world.

The survey chapter is also comprehensive, covering both written questionnaires and interviews. Again reliability and validity rightly dominate the discussion, with a useful section on single and multiple item scales, and levels of measurement. As one might expect from an author whose work has been strongly oriented towards these issues, it covers many practical points, criticising current weaknesses in measurement, scaling and instrument development, with which I would concur. However, I was disappointed to find the Southwood (1978) reference being used yet again to dismiss the possibility of interpreting lower order regression coefficients in multiple regression models where a ratio level of measurement has not been attained. This argument always seems to overlook the possibility of comparing work conducted on different samples, but using the same measurement instruments; comparison under these conditions is surely valid.

The final main chapter is on case study methods, somewhat to the author's own surprise, as he is relatively inexperienced in their use, and closely follows the work of Yin (1989). Within this limitation, it examines how case-based approaches can be used in ways that are both valid and reliable, with an interesting section on the participant observer's role. Attention is also paid to the tricky issues of recording and analysing data obtained from the multiple methods of observation typically used. Excellent though the presentation of this approach is, it hides a more fundamental issue, namely that of the hypothesis-testing framework within which Yin's work is developed. Nothing is said about the inductive development of theory, or the construction of 'grounded theory' of any kind.

The assumptions lying behind this chapter, and indeed the whole text, are those of a positivist and hypothesis-testing approach drawn more from the natural sciences than from the social sciences (although it has to be conceded that such a framework lies behind much work in the social sciences as well). Other methodological paradigms are not mentioned.

The text could have ended at this point, covering in just 78 pages the essence of empirical research methods for positivist hypothesis testing. But another 103 pages of text now follow, illustrating the previous discussion by the incorporation of three 'case studies'. These are based on three well-known, published papers, one drawn from each of the three traditions discussed. Not only is a brief discussion of each included in Chapter 5, but the full transcript of the interviews with the three researchers involved is given in an Appendix.

To me, this is the high point of the whole book. Most published papers leave unmentioned the many practical choices the researcher has to make about every aspect of the chosen research design. In these discussions, such points are drawn out and probed in some depth. These sections could well be assigned to doctoral discussion groups with considerable profit, each individual paper being worth at least one seminar. I am sure students will learn more about doing real research from these sections than they will until they have found out the rest for themselves the hard way!

So, here we have a book that I found to be both stimulating and infuriating. Stimulating because of the clarity of thought and presentation that has been incorporated into it, and because of the vivid analysis of real pieces of work by leading researchers. Infuriating, because of the limited perspective that has been applied to the discussion of the case study method, which eliminates most of the applications in which this method has been found to be of use (see Otley and Berry [1994] for a fuller discussion). But with that one proviso, I would recommend it for undergraduate honours students, doctoral students and all researchers working in management accounting; it will prevent many mistakes being made and carried through to a point when it is too late to rectify them.

Lancaster University David Otley

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Accounting Innovation: Municipal Corporations 1835–1935. *Hugh M. Coombs and John Richard Edwards.* Garland, 1996. xiii + 204pp. $57.

This 10-chapter book is based on five previously-published papers, two of which appeared in this journal. The research that underpins it was financially supported by the ICAEW's Research Board, and was explicitly informed by the contents of government reports, secondary material from the mid-1870s onwards, and the archives of five major municipal corporations.

The significant part of the book is true to its title. The contribution that this material makes is to give more detail about when accounting changed in the 19th century boroughs, and about what kinds of individuals were involved in the changes. Stopping short of attempting to demonstrate causation, the authors conclude that '(i)nnovation occurred initially, at the level of the corporation, where an important contribution was made, beginning in the 1850s, by professional accountants' (p. 179). What they mean by the phrase 'professional accountants' is that these people were not employees of the corporations; rather they were paid to act as auditors who thereby supplanted the 'amateur' elective audit. Subsequent innovations were also stimulated by the growing numbers of accountants who were corporation employees, and by the body that represented them from 1885 onwards (the forerunner of CIPFA). And the authors conclude that the process of innovation 'went far beyond the minimum statutory framework of accountability, established in 1835, which was expanded only to a small extent over the next 100 years' (p. 181).

These conclusions, if not especially interesting, are relatively easy to accept. They are also offered as contradictions to my thesis in *The History of the Financial Control Function of Local Government Accounting in the UK* (in the same series, 1992), but this is hard to accept. That book did not address the process of accounting innovation; perhaps it should have but it did not. Its main conclusion (that the essentials of local government accounting are methods of imposing financial control on elected councillors, basically determined by statute) is expressed in the present tense; this overtly emerges from an historical context, but nowhere does the book state that the law was responsible for accounting innovation. Instead, it explains that relevant contemporary accounting methods can be found in the law, past and present, and can be explained as financial controls. Even a cursory examination of the development of statute law would forewarn anyone of the dangers of assuming that statutes were the initiators of practices.

Notwithstanding, researchers who are interested in 19th century accounting innovation in local government will want to read this book. But an important caveat needs to be added. There is other material in it about which the same cannot be said. For example, there are pieces that trivialise both the periods before 1835 (pp. 10–11) and periods after 1935 (pp. 157–158). But these will be easy to skip. What will provide greater difficulty for the unwary are the extraordinary lapses that occur.

On page 22 we read: 'Following the introduction of the rating system, in 1597', whereas the first statutory rate was over 150 years earlier than this; 1597 was not even the beginning of statutory poor-law rates. On page 54 it states: 'At the start date (the creation of the municipal corporation) and the end date for this study...' Municipal corporations were not created in 1835; we do not strictly know when they were created, but by the late Middle Ages (at the latest) will suffice for this purpose. Table 3.1, on page 25, is headed: 'Significant events in the history of municipal corporations' and begins: Pre-1835—Boroughs run as clubs for the benefit of local officials—characterised by mismanagement and corruption.'

And finally, the perhaps more harmless: 'The present structure of local and central government is considered to be mainly the product of the thinking of Jeremy Bentham' (p. 12).

Accounting historians will long be in debt to other historians, including to economic, business, urban and local historians; material such as the above provides no basis for beginning to pay them back.

University of Birmingham Rowan Jones

Occasional Reviewers

Manuscripts submitted to *Accounting and Business Research* during 1995 have been reviewed by members of the Editorial Board and the following ad hoc reviewers. Their support is greatly appreciated. *The Editors.*

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Papers should be in English and consist of original unpublished work not currently being considered for publication elsewhere. They should be typed and double-spaced. *Four* copies should be submitted, together with a submission fee of £18 for subscribers or £36 for non-subscribers. In order to ensure an anonymous review, authors should not identify themselves, directly or indirectly. Experience has shown that papers that have already benefited from critical comment from colleagues at seminars or at conferences have a much better chance of acceptance. Where the research takes the form of field surveys or experiments, *four* copies of the instrument should be submitted. Where the paper shares data with another paper, *four* copies of the other paper must also be provided.

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A cover page should show the title of the paper, the author's name, title and affiliation, and any acknowledgements. The title of the paper, but not the author's name, should appear on the first page of the text. An abstract of 150–250 words should be provided on a separate page immediately preceding the text. Section headings should be numbered using Arabic numerals.

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Each table and figure should bear an Arabic number and a title and should be referred to in the text. Sources should be clearly stated. Sufficient details should be provided in the heading and body of each table and figure to reduce to a minimum the need for cross-referencing by readers to other parts of the manuscript. Tables and figures should appear at the end of the paper, with its most appropriate placing noted in the paper itself. Diagrams and charts should be submitted in camera-ready form.

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Abbreviations of institutional names should be written as, for example, FASB and not F.A.S.B; those of Latin terms should contain stops (thus i.e. not ie). Words such as 'realise' should be spelled with an 's' not a 'z'. Single quotations marks should be used, not double.

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